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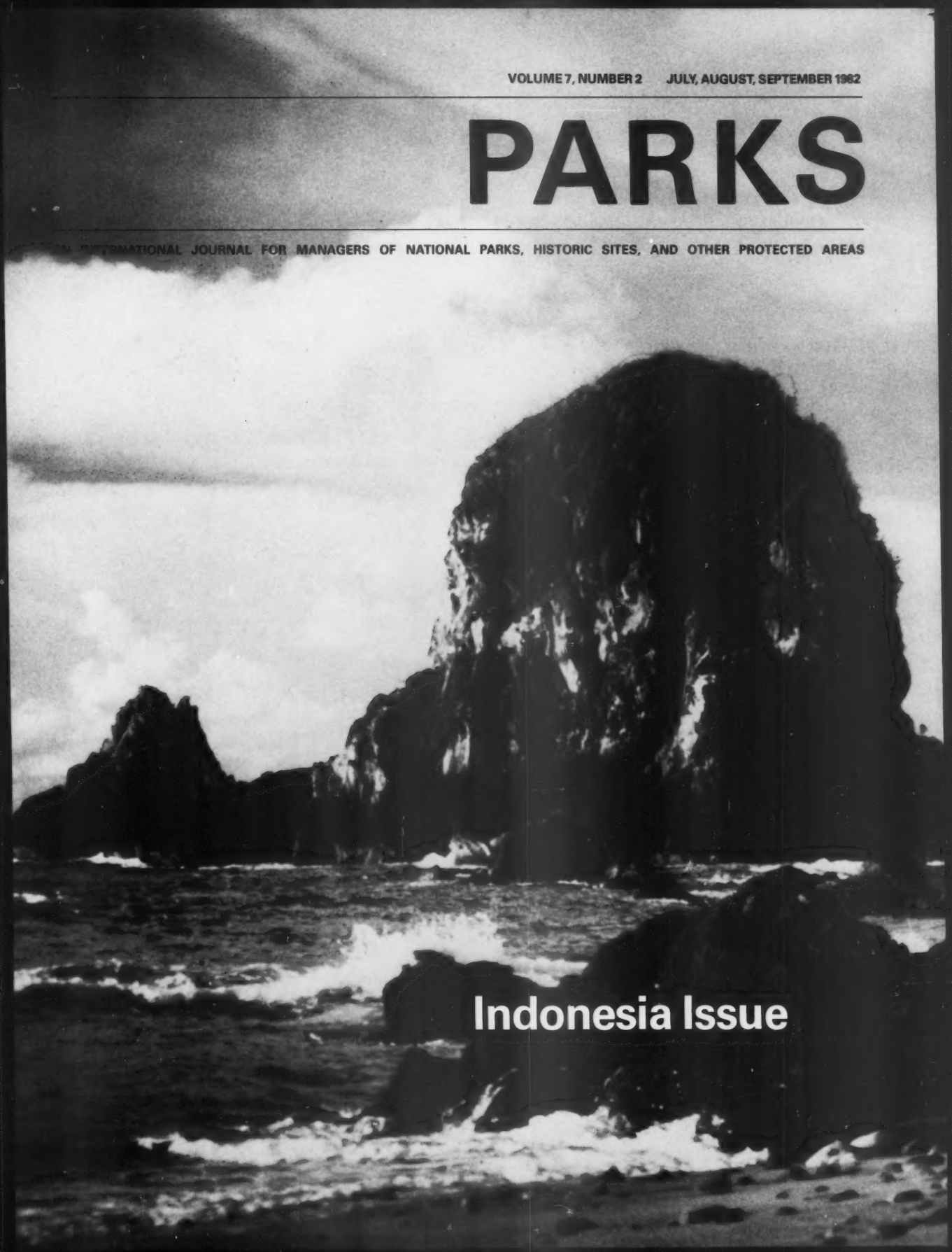

Indonesia Issue

PARKS

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Front Cover: The rugged coastline of Ujung Kulon National Park, at the western end of the island of Java, discloses its volcanic origin. Photo: Jeffrey A. McNeely

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Rodney V. Salm, Sumarjono Sudargo, and Endang Mashudi

Marine Conservation in Indonesia

The development of marine conservation in Indonesia is still in its formative stage. At the moment only 2 percent of the staff of the Directorate of Nature Conservation (PPA) work exclusively on marine conservation. Only 1.1 percent of all the established parks and reserves are exclusively marine (i.e. marine parks at Pulau Banda, Pulau Pombo and Pulau Kasa in the Moluccas), and they lack management plans. However, some terrestrial protected areas which border the sea also make a useful contribution to marine conservation.

Previous projects working with PPA, such as the UNDP/FAO National Parks Development Projects or the World Wildlife Fund Indonesia Program, have had minor marine components. At first glance this disparity between land and sea may seem incredible in an island nation whose territory is 70 percent ocean (excluding the 200-mile Exclusive Economic Zone). But it is understandable. Endemism, which is far more prevalent on the islands than in the sea, has endowed the land with many unique species now threatened with extinction. The survival of these species and of vanishing habitats has been of paramount concern, especially since it is in direct conflict with the increasing needs for land by Indonesia's expanding population. Such conflicts are all far more visible on land than underwater and, from the conservation point of view, they have been far more urgent. The loss of such species and forests from Indonesia is a total loss from the world. The loss of marine species (e.g. turtles or dugongs) or habitats (e.g. coral reefs or mangroves) would be Indonesia's loss alone. These would survive elsewhere in the world, albeit in a world poorer for the loss. While the struggle continued on land to prevent total extinctions, marine issues were relegated to lower priority. Species, such as giant clams, *Tridacna gigas*, were eliminated from much of their former range. Whole families of certain commercially valuable fishes (e.g. carangids, lutjanids, lethrinids, serranids) became rare or actually disappeared on many reefs. Naturally productive habitats, such as coral reefs and mangroves, were degraded by damaging fishing practices, pollution, siltation or clear cutting. Now attention has turned to the sea.

PPA has found itself with the mandate to protect, conserve and manage coastal and marine habitats valuable to fisheries and tourism in addition to strict conservation, and of all endangered, vulnerable or depleted species. That 2 percent of the PPA staff has a task too large for even the remaining 98 percent. Expansion of the marine conservation program is planned during the upcoming 5 year development cycle which begins in 1984.

Current Status of Marine Conservation

During 1981 a Marine Conservation Section was formed within PPA. The section has a staff of four of which only one so far has training in marine science (actually fisheries management), experience in snorkelling, diving and survey. The section falls under the Subdirectorate of Nature Reserves and Protection Forests. Marine National Parks fall under the Subdirectorate of National Parks and species conservation falls under a third Subdirectorate, Species Conservation. Although not ideal, this arrangement is a starting point. Consolidation of marine activities can only occur with further development of expertise. The building of a Subdirectorate of Marine Conservation will be a goal of the next development phase in PPA.

The progress in establishment of protected marine areas is summarized in Table 1 (see also Robinson *et al*, 1981). Their locations are depicted in Figs. 1 and 2. There are three marine parks, two recreation parks and seven marine reserves declared but awaiting management plans and development. A further three marine parks (including one marine national park) and 28 reserves have been proposed. Seaward extension of the boundaries of one reserve has been effected and is proposed for three national parks and a further seven reserves, one of which (Bali Barat-Pulau Menjangan) would be upgraded to a national park. A total of 24 terrestrial parks and reserves which border the sea have a coastal component (e.g. turtle nesting beach or mangrove). These areas contain a variety of elements, some more important than others.

There are three small coral reef reserves in Indonesia, all in the Moluccas. They include marine parks at Pulau Banda, Pulau Pombo and Pulau Kasa. Their total area is 4,600 ha. The process of establishment has progressed as far as legal declaration and some limited management. Formulation of management plans and their implementation is the next step. The boundary of Tangkoko-Batuangus Strict Nature Reserve has been extended 500 m seawards to include offshore reefs. Additional reef areas will be protected by extension of national park boundaries at Komodo, Ujung Kulon, Krakatau, Baluran and Bali Barat. Of these Bali Barat probably makes the greatest contribution to reef conservation, but their total value in the national perspective is small.

Indonesia has a great variety of reef types (patch, ocean atoll, shelf atoll, barrier and fringing reefs, faroes, knolls and shoals) of large size, high species diversity and considerable value. These important reefs are being surveyed and suitable locations are being proposed as reserves. The goal will be to retain the value of these reefs to fisheries, research and recreation by establishment of a network of coral reef reserves and national parks linked by current corridors whose function will be to safeguard breeding stocks of valuable commercial species, samples of different reef environments and communities, and areas of value to tourism, research and education.

There are 120 reserves which have the protection of mangroves as a principal aim. Mangroves are also found bordering 14 other protected areas where they are of secondary interest. A further nine proposals for mangrove reserves have been approved by regional governors and a great number of proposals are being processed. Proposals will be solicited from the Department of Fisheries and research institutions to help estab-

Table 1. Existing and proposed marine protected areas and terrestrial protected areas with marine components in Indonesia

Category	No.	Name of Area*	Province	Area (Ha) Total	Coral Reef	Mangrove	Marine Conservation Elements
Declared Marine Park/Reserve							
1. Management/Protection Established	—	—	—	—	—	—	—
2. No Fully Established Management/Protection	1.	Mas-Popaya-Raja SNR	N. Sulawesi	160	—	—	seabirds
	2.	P. Kasa MP	Maluku	1,100	1,000	—	coral reef
	3.	P. Pombo MP	Maluku	1,000	500	—	coral reef
	4.	P. Banda MP	Maluku	2,500	?	—	coral reef
	5.	Gunung Api SNR	Maluku	80	—	—	seabirds
	6.	P. Manuk WR	Maluku	100	—	—	seabirds
	7.	Sabuda—Tataruga WR	Irian Jaya	450	50	—	nesting turtles, coral reef
	8.	Teluk Yotefa RP	Irian Jaya	1,650	—	—	recreation
	9.	Muara Angke SNR	Jakarta	15.4	—	15.4	mangrove
	10.	P. Kembang RP	S. Kalimantan	60	—	?	mangrove, recreation
	11.	P. Kaget WR	S. Kalimantan	85	—	85	mangrove
	12.	Teluk Kelumpang, SNR	S. Kalimantan	66,650	—	13,750	mangrove
	13.	Hutan Bakau Pantai Timur Jambi SNR	Jambi, Sumatra	6,500	—	6,500	mangrove
Proposed Marine Park/Reserve	14.	P. Weh-P. Beras SNR	Aceh, Sumatra	3,000	—	—	coral reef
	15.	Siberut (Teluk Sarabuda, P. Kecil, P. Panjang, P. Saibi, P. Kaininggit, P. Laba Buinan) SNR	West Sumatra	15,227	?	?	coral reef, mangrove
	16.	P. Tikus SNR	Bengkulu, Sumatra	—	?	—	coral reef
	17.	P. Seribu MNP	Jakarta	108,000	?	?	coral reef, fringing mangrove, nesting green & hawksbill turtles research & education, tourism
	18.	Segara Anakan Nusakambangan SNR	Central Java	22,077	?	?	coral reef, mangrove, nesting green turtle
	19.	Karimunjawa WR	Central Java	111,625	?	—	coral reef, tourism
	20.	P. Pemenang MP	Nusa Tengrara	2,000	?	—	coral reef, tourism
	21.	P. Karimata SNR	W. Kalimantan	77,000	10,000	—	coral reef
	22.	Semana—Sangalaki SNR	E. Kalimantan	?	1,000	—	nesting green & hawksbill turtles, coral reef
	23.	P. Maratua—Karapg Muaras SNR	E. Kalimantan	?	10,000	—	coral reef
	24.	P. Birah-Birahan SNR	E. Kalimantan	?	?	?	coral reef, beach vegetation, nesting turtles
	25.	Pamukan SNR	E. Kalimantan	10,000	—	10,000	mangrove
	26.	Muara Sebuku SNR	E. Kalimantan	110,000	—	55,000	mangrove
	27.	Kepulauan Bunaken MP	N. Sulawesi	49,375	?	?	coral reef, mangrove, tourism
	28.	P. Pasoso WR	Central Sulawesi	?	?	—	coral reef, nesting green turtles
	29.	P. Togian MMUR	Central Sulawesi	?	?	?	coral reef, coconut crab, nesting green & hawksbill turtles, dugong, mangrove
	30.	P. Peleng SNR	Central Sulawesi	?	?	?	dugongs, coral reefs, nesting green turtles
	31.	P. Samalona SNR	S. Sulawesi	5,000	?	—	coral reef, nesting green turtles
	32.	Kawi-Kawi (=Kakabia) SNR	SE. Sulawesi	?	—	—	seabirds
	33.	Teluk Dalam—Teluk Lasolo SNR	SE. Sulawesi	?	?	—	coral reef, dugong
	34.	Selat Wawonoi SNR	SE. Sulawesi	?	?	—	coral reef, dugong
	35.	Selat Muna SNR	SE. Sulawesi	?	—	—	no information
	36.	P. Penyu SNR	Maluku	?	?	—	coral reef, nesting green turtles
	37.	Aru Tenggara SNR	Maluku	200,000	?	?	dugongs, nesting green & hawksbill turtles, saltwater crocodile, coral reef, mangrove
	38.	Raja Ampat SNR	Irian Jaya	2,976	?	—	coral reef
	39.	Kepulauan Ayu—Asia WR	Irian Jaya	904	?	—	coral reef, green turtles
	40.	N. Coast Vogelkop (5 beaches) WRs	Irian Jaya	?	—	—	nesting green & leatherback turtles
	41.	Teluk Bintuni SNR	Irian Jaya	450,000+	—	450,000	mangrove
	42.	Teluk Cenderawasih MR	Irian Jaya	?	80,000	?	nesting green & hawksbill turtles, dugong, saltwater crocodile, *Tridacna gigas* & other giant clam species, coral reef, mangrove
	43.	P. Mapia WR	Irian Jaya	1,557	?	—	coral reef, nesting hawksbill turtles
	44.	P. Sayang WR	Irian Jaya	?	—	—	nesting hawsbill turtles
Declared Terrestrial Reserves Bordering the Sea							
1. Seaward Extension Exists	45.	Tangkoko—Batuangus SNR	N. Sulawesi	1,250	?	—	coral reef
2. Seaward Extension Proposed	46.	Krakatau Islands WR	W. Java	?	?	—	coral reef, nesting green & hawksbill turtles, research & education

lish protection and management of those mangrove areas most valuable to fisheries production, research, education and conservation of genetic resources. There remains the need to classify mangroves by type, diversity, biological production, contribution to fisheries and value to endemic or particular species, and to include examples of each into the reserve system.

Turtle nesting beaches are well protected in two reserves, Meru Betiri and Cikephu, and one national park, Ujung Kulon, all on South Java. They receive varying amounts of protection in six other reserves. However, relative to other nesting beaches in Indonesia these are of less importance. Pulau Semama, East Kalimantan, has recently been declared a turtle reserve by local government. Once approved and declared a reserve by central government, enforcement can begin and Indonesia will have an important green turtle reserve. It is not known to what extent Indonesia shares its turtle populations with neighboring countries. There is evidence that the green turtles, *Chelonia mydas,* of East Kalimantan are part of a larger population shared by Indonesia, Sabah and the Philippines, that the turtles of northwest Kalimantan are shared with Sarawak, that the leatherbacks, *Dermochelys coriacea,* of Irian Jaya are part of a population shared with northern Papua New Guinea and that the leatherbacks of south Sumatra are shared with the Andaman and Nicobar Islands. Clearly the conservation of turtle stocks in Indonesia will require multinational cooperation.

Of the five turtle species regularly occurring in Indonesia only three are protected by law (leatherback, olive ridleys and loggerhead). The remaining two species (green and hawksbill) suffer heavy and unregulated exploitation. There are plans to achieve sustainable harvest of these two species, but not protection.

Dugong habitats as yet are not protected anywhere in Indonesia. Although dugongs themselves are protected, this law is not generally known or adhered to by coastal residents who continue to hunt them. There is still very little known of their distribution and movement, location and size of populations and conservation needs here.

A dugong sanctuary has been proposed off southeast Aru. When established, this site will help safeguard what is probably Indonesia's largest dugong population. The proposed Teluk Cenderawasih Reserve in Irian Jaya also has the protection of dugongs and their habitats as one of the principal aims. Extension of the boundaries of existing protected areas in

Table 1. *(continued)*

Category	No.	Name of Area*	Province	Area (Ha) Total	Coral Reef	Mangrove	Marine Conservation Elements
	47.	Ujung Kulon NP	W. Java	72,000	?	?	coral reef, mangrove, nesting green and rarely leatherback turtles
	48.	Sancang Cipatijah WR	W. Java	2,500	?	?	mangrove, nesting turtles
	49.	Pananjung—Pangandaran SRN + RP	W. Java	2,500	?	—	coral reef, recreation
	50.	Baluran NP	E. Java	4,000	?	?	coral reef, mangrove, milkfish fry nursery
	51.	Bali Barat—P. Menjangan WR	Bali	6,220	810	310	coral reef, mangrove, tourism
	52.	P. Moyo WR	Nusa Tenggara	?	?	—	coral reef
	53.	Komodo-Padar-Rinco NP	Nusa Tenggara	34,271	?	?	coral reef, mangrove, turtles, plankton rich seas, whale sharks, manta rays, whales
	54.	Tanjung Api SNR	Central Sulawesi	?	?	—	coral reef
	55.	Anggremeos WR	Irian Jaya	2,500	?	?	coral reef, mangrove, dugong
3. No Seaward Extension, but includes Marine Component	56.	P. Berteh WR	E. Sumatra	500	—	?	mangrove
	57.	Berbak WR	Jambi, Sumatra	190,000	—	?	mangrove
	58.	Way Kambas WR	Lampung, Sumatra	130,000	—	?	mangrove
	59.	Sumatra Selatan WR	Lampung, Sumatra	356,800	—	—	nesting green turtles
	60.	P. Dua SNR	W. Java	8	—	?	mangrove, waders**
	61.	P. Bokor SNR	Jakarta	15	—	—	waders**
	62.	P. Rambut SNR	Jakarta	18	—	?	mangrove, waders**
	63.	Cikepuh WR	W. Java	8,127.5	—	—	nesting green turtles
	64.	Teluk Baron SNR	Yogyakarta, Java	2.4	—	—	? recreation
	65.	Nusa Barung SNR	S. Java	6,100	—	—	nesting green turtles
	66.	Meru Betiri WR	E. Java	50,000	—	—	nesting green, hawksbill, leatherback & ridleys turtles
	67.	Banyuwangi Selatan WR	E. Java	62,000	—	—	nesting green turtles
	68.	P. Manipo WR	Nusa Tenggara	2,000	—	—	seabirds
	69.	Tanjung Puting WR	Central Kalimantan	335,000	—	11,000	mangrove**
	70.	Kutai WR	E. Kalimantan	200,000	—	?	mangrove**
	71.	Pleihari Tanah Laut WR	South Kalimantan	35,000	—	4,000	mangrove,** nesting green turtles
	72.	Panua SNR	N. Sulawesi	1,500	—	?	mangrove
	73.	Morowali SNR	Central Sulawesi	200,000	—	?	mangrove**
	74.	Lampoko-Mapie WR	S. Sulawesi	2,000	—	?	mangrove
	75.	Tanjung Peropa WR	SE. Sulawesi	38,000	—	?	mangrove
	76.	Watumohai HP	SE. Sulawesi	50,000	—	?	mangrove
	77.	Gunung Lorentz SNR	Irian Jaya	1,675,000	—	301,500	mangrove**
	78.	P. Dolok WR	Irian Jaya	600,000	—	99,000	mangrove**
	79.	Wasur WR	Irian Jaya	225,000	—	6,180	mangrove**

*P. = Pulau (= island), MP. = Marine Park, MNP/NP. = Marine National Park/National Park, RP. = Recreation Park, HP. = Hunting Park, SNR. = Strict Nature Reserve, MR./WR. = Marine Reserve/Wildlife Reserve, MMUR. = Marine Multiple Use Reserve.

**Element of major interest

Kalimantan to include offshore dugong habitats will further safeguard dugong stocks. There are four other proposed reserves in which dugongs reputedly occur. Like turtles, dugong populations are almost certainly shared by Papua New Guinea and Indonesia and their management would benefit from collaborative efforts. Here Indonesia can benefit greatly from the experience of dugong census and conservation in Papua New Guinea.

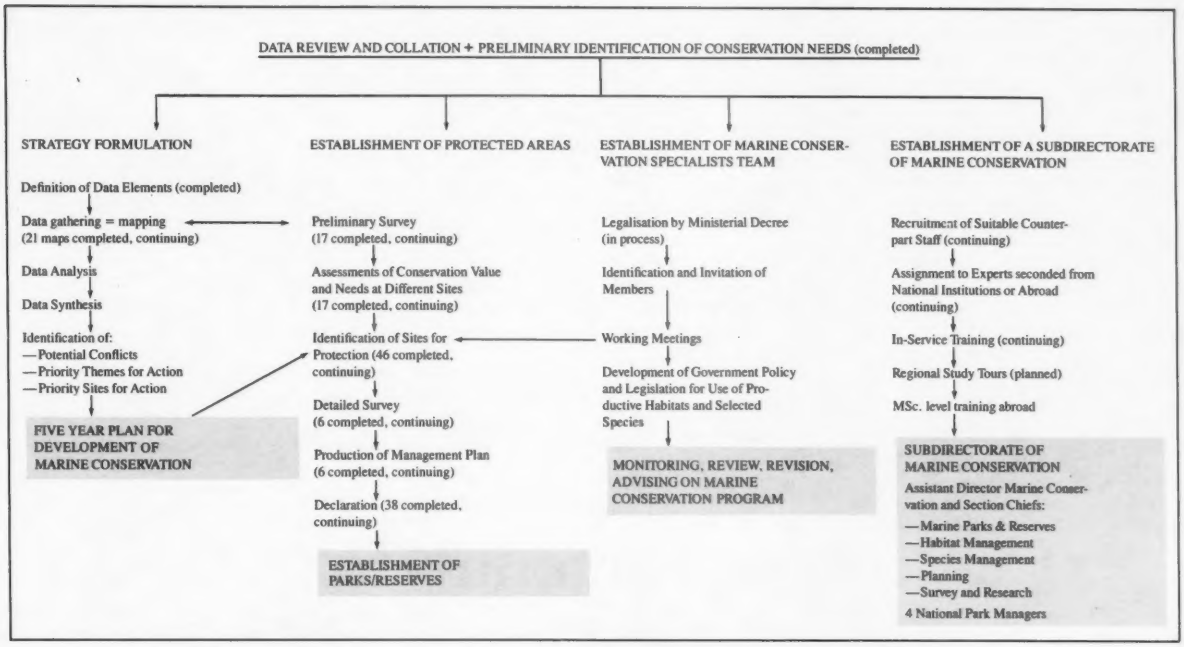
All whales and dolphins are protected in Indonesia. Other than the small-scale traditional whale fishery off Lembata Island there is no whaling in Indonesian seas. Indonesia has a vital role to play in the Indian Ocean Sanctuary as the major migration route for great whales between the Indian and Pacific Oceans is through the Banda Sea and Straits between Timor and Flores Islands. Indonesia has not ratified the Indian Ocean Sanctuary or acceded to the International Convention for the Regulation of Whaling to become a voting member of the International Whaling Commission. These are currently under consideration.

Still underrepresented in protected areas are samples of beach forests, seabird nesting sites and rookeries, mudflats important as feeding areas for migrating waders and the habitats of marine invertebrates (such as giant clams, commercial trochus, pearl oysters, and coconut crabs) which are seriously depleted in some areas and urgently in need of management. No marine invertebrates are protected in Indonesia. Reserves are proposed for seabirds and some marine invertebrates, but important mudflats and beach forests have still to be identified.

Fig. 1: Declared marine protected areas and terrestrial protected areas with marine components. (numbers from table 1)

Fig. 2: Proposed marine protected areas and terrestrial protected areas with marine components. (numbers from table 1)

Fig. 3 Design achievements and principal goals of the marine conservation program, Indonesia


DATA REVIEW AND COLLATION + PRELIMINARY IDENTIFICATION OF CONSERVATION NEEDS (completed)
STRATEGY FORMULATION
Definition of Data Elements (completed)
Data gathering = mapping (21 maps completed, continuing)
Data Analysis
Data Synthesis
Identification of:
—Potential Conflicts
—Priority Themes for Action
—Priority Sites for Action
FIVE YEAR PLAN FOR DEVELOPMENT OF MARINE CONSERVATION
ESTABLISHMENT OF PROTECTED AREAS
Preliminary Survey (17 completed, continuing)
Assessments of Conservation Value and Needs at Different Sites (17 completed, continuing)
Identification of Sites for Protection (46 completed, continuing)
Detailed Survey (6 completed, continuing)
Production of Management Plan (6 completed, continuing)
Declaration (38 completed, continuing)
ESTABLISHMENT OF PARKS/RESERVES
ESTABLISHMENT OF MARINE CONSERVATION SPECIALISTS TEAM
Legalisation by Ministerial Decree (in process)
Identification and Invitation of Members
Working Meetings
Development of Government Policy and Legislation for Use of Productive Habitats and Selected Species
MONITORING, REVIEW, REVISION, ADVISING ON MARINE CONSERVATION PROGRAM
ESTABLISHMENT OF A SUBDIRECTORATE OF MARINE CONSERVATION
Recruitment of Suitable Counterpart Staff (continuing)
Assignment to Experts seconded from National Institutions or Abroad (continuing)
In-Service Training (continuing)
Regional Study Tours (planned)
MSc. level training abroad
SUBDIRECTORATE OF MARINE CONSERVATION
Assistant Director Marine Conservation and Section Chiefs:
—Marine Parks & Reserves
—Habitat Management
—Species Management
—Planning
—Survey and Research
4 National Park Managers

The Developing Programme

The principal problem facing marine conservation in Indonesia is how to control the continued destruction of productive habitats (such as mangroves, estuaries and coral reefs) that are important to the livelihood of local residents and to the national economy. [Total value of recorded fisheries production in 1979 was $537,548,800 (Anon, 1980) and of exports was $236,827,000 (Anon, 1981)]. Also a major problem is control of the current heavy exploitation of endangered and vulnerable species, such as turtles, dugongs, giant clams and coconut crabs, which have already been eliminated from parts of their former range, so that these can continue to contribute to the communities which currently exploit them. This does not touch on other important conservation needs including those mentioned in the preceding paragraph. Certain of these former species and habitats may well be critically endangered in Indonesia. However, as we know so little about them, as they are of less socioeconomic importance than the latter or are not globally endangered, and limited in scope by inevitable financial constraints, we are justified in concentrating initial efforts on the conservation and management of reefs, mangroves, turtles and dugongs.

Consistent with the objectives of the World Conservation Strategy, the overall objective of Marine Resource Conservation and Management in Indonesia is to achieve controlled development of the marine environment, sustainable utilization of Indonesia's diverse marine resources and protection of habitats critical to the survival of commercially valuable, endangered, vulnerable and other selected marine species. Toward this end PPA will establish a system of marine multiple use, resource and strict nature reserves and marine national parks, build within it a cadre of suitably trained personnel to manage these areas and to continue development of marine conservation, help develop public education programs, essential legislation and appropriate enforcement tactics, and cooperate with other relevant research and management agencies.

The design, achievements and principal goals of the developing marine conservation programme are outlined in Fig. 3.

There are four broad activities of this programme. Strategy formulation and establishment of a marine conservation specialists team are the beginning and lead to the longer-term objectives: establishment of protected areas and establishment of a Subdirectorate of Marine Conservation. There has been progress in all four activities.

Formulation of a marine conservation strategy is well under way. The data elements have been defined and maps have been completed for 21 of these. Lack of funds for the production of a data atlas is all that is holding back its completion and definition of a five-year Plan for the development of marine conservation.

A ministerial decree to legally establish the Marine Conservation Specialists Team has been drafted and is being processed through government. The Team will begin functioning this year.

Progress in the establishment of protected marine areas has been detailed above. The first marine national park and seaward extensions to the boundaries of four national parks will be established this year.

Training of personnel by attachment of PPA staff to FAO and WWF personnel has progressed slowly. Expertise in aspects of marine conservation will be developed gradually over the next 6 years. It is intended that the nucleus of a Subdirectorate of Marine Conservation will be established by the end of 1988.

The Need for a Regional Perspective

ASEAN nations are linked by ocean currents and shared seas. Their marine resources are not restricted to different land masses and many populations, such as turtles, dugongs, whales and oceanic fishes, may be shared by two or more countries. Neglect on the part of one country to manage a critical habitat of one species, e.g. turtle nesting beach or whale migration corridor, may mean its disappearance off a neighboring nation. Similarly, pollution or the destruction of productive habitats, e.g. coral reefs, mangroves and estuaries, in one country may affect production off its neighbor's shores down current. Larvae of organisms breeding in these ecosystems or nutrients produced there may be indispensable for the replenishment of areas far removed.

Perhaps more than for on land, there is the need for multinational collaboration and regional strategies for the conservation and management of marine resources. The two most obvious sites for collaboration between nations are northwest Kalimantan — southwest Sarawak for a turtle reserve (the only loggerhead turtles nesting in Indonesia may be those spilling over from Sarawak into the Hutan Sambas area of Kalimantan); and a northeast Kalimantan — Sabah — Philippines reserve in the southwest Sulu Sea for coral reefs and nesting green turtles. At the policy level the most obvious need is for collaboration in the conservation of whales. For example, whales are protected by a Ministerial Decree in Indonesia, but the government has not yet joined the International Whaling Commission. The Philippines is a voting member. Yet the great whales migrating between the Indian and Pacific Oceans pass through a restricted corridor extending N-S through Indonesia where they are most vulnerable to disturbance and hunting. Earlier this year there was an incident of fin whale poaching in the straits between Halmahera and N. Sulawesi. These whales were evidently migrating from Indonesian to Philippine waters.

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Dr. Rodney V. Salm is an FAO marine ecologist working with the FAO/UNDP National Parks Development Project in Indonesia. He can be reached c/o UNDP, P.O. Box 2338, Jakarta.

Dr. Sumarjono Sudargo is Technical Assistance Coordinator for the Directorate of Nature Conservation and Wildlife Management (PPA) in Indonesia. He is on leave from the Bogor Institute of Agriculture.

Dr. Endang Mashudi is a member of the Technical Assistance Staff with the Directorate of Nature Conservation and Wildlife Management (PPA), Bogor.

H. M. Duryat and
L. P. van Lavieren

Training Personnel for Indonesia's Protected Areas

Prior to independence a start was made on establishing a system of nature reserves in Indonesia. The protection and management of these reserves was the responsibility of the Botanical Gardens, Bogor. Since 1957 nature conservation has come under the umbrella of the Forestry Department and in 1971 a separate Directorate of Nature Conservation was created within this department. As a result, the majority of the staff in charge of the management of nature reserves has been recruited from officers with a forestry education.

Although these foresters have contributed substantially to the establishment and maintenance of nature reserves in Indonesia, in many ways forestry training does not cover the multifarious aspects of nature conservation and wildlife management. Apart from further training most foresters need to re-orientate their approach towards non-consumptive uses of tropical primeval forests.

In Indonesia today a total of 11.2 million ha of land and sea has been set aside for nature reserves; this is a four-fold increase over the last eight years. The planning, development and management of such a huge area (about 3½ times the size of the Netherlands) requires large numbers of properly trained personnel at various levels of responsibility.

Recently, a number of biologists and ecologists have been trained at Indonesian universities but as in most university courses, their training has been theoretical rather than aimed at solving practical problems encountered in managing nature reserves. The day-to-day management of protected areas is in fact the task of the warden or superintendent. This paper reports on a training course for wardens organized since 1978 at School of Environmental Conservation Management, Ciawi, West Java. It discusses our experiences so far, the constraints encountered and suggests future steps towards regional cooperation in South-East Asia.

Manpower planning

In general three categories of personnel for management of protected areas can be identified. At the highest level are directors and subdirectors and university-trained biologists, ecologists and other specialists. Park planning, wildlife and habitat management, outdoor recreation and visitor management have attained the status of separate disciplines at many universities in both temperate and tropical regions of the world. The main tasks of these specialists are to conduct in-depth ecological and biological studies, inventory and survey the protected ecosystems, to study the behavior, needs and impact of visitors, to develop methods and techniques for the management of wildlife and habitat, to evolve a program of conservation education and interpretation, to design and supervise the construction of the area's infrastructure and to establish laws and regulations. In most countries the planning, establishment and management of reserves has now become such a complex issue that only a team of specialists can do the job properly, guaranteeing that no area of potential conflict is overlooked. Most conservation departments in developing countries cannot afford to employ many specialists on a full-time basis and have to resort to cooperation with universities and other research institutions.

The second category of personnel includes intermediate level staff, such as park superintendents and wildlife wardens. Their principal task is the supervision and implementation of management programs and the day-to-day running of the areas as recreational sites for visitors. Proper training of intermediate level of staff is crucial for the success of conservation programs. Not only are they the first to be aware of undesirable biological and ecological changes, encroachments and infringements,

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but they must also be able to analyze the causes and to implement measures for solving the problems.

The third category of personnel is the subordinate staff, including guards, scouts and guides. Their tasks are many and various and may include law enforcement activities and visitor control but also such duties as making inventories or routine observations of wildlife and habitat, assisting research scientists and the control of problem animals. Their training is usually organized in brief (1 to 3 months) in-service courses in the field.

Manpower planning has become a matter of urgent concern in the Directorate of Nature Conservation of Indonesia (PPA). Over the last eight years, the acreage of protected areas in Indonesia has increased enormously. Moreover, the area of reserves and parks is to be expanded further during the forthcoming Five Year-Plan, starting in April 1983, to around 20 million hectares. Many of the existing and newly established reserves include important catchment areas and play a vital role in the well-being of the low-income rural population of Indonesia. Thirdly, the management of existing reserves must be improved and intensified as many are under mounting pressure from human encroachment. This is not surprising if we look at the actual population increase. In December 1981 Indonesia's population was estimated to be 154.3 million. (US Bureau of Statistics) and the population census of 1980 revealed a crude rate of natural increase of 2.34 percent per annum.

If this pattern is maintained, the population of Indonesia will have reached the 300 million mark by 2011. (The official expectation for the year 2000 is 210 million if population control measures are successful; if not 230 million is predicted).

In view of the expected expansion of its responsibilities, PPA will require an increasing number of staff at all levels. As assessment of required manpower was made in 1981 for both PPA-headquarters in Bogor and for staffing the regional units (Lukito Daryadi, 1981). A summary of PPA's future staff requirements is given in Table 1.

School of Environmental Conservation Management, Ciawi.

The School of Environmental Conservation Management was established in 1978 as a joint endeavor between the governments of Indonesia (Ministry of Agriculture, Agency for Agricultural Education, Training and Extension) and the Netherlands (Ministry of Foreign Affairs, Directorate General of International Cooperation). The School is located in Ciawi, West Java. The principal objectives of the School are to train the intermediate level personnel (Kepala Balai and Kepala Sub-Balai) for the Directorate of Nature Conservation of Indonesia. Since its creation the school has enjoyed generous financial, technical and moral support from both the Indonesian and the Netherlands Governments. The Indonesian contribution includes all running costs, buildings and facilities, catering and lodging of the participants, teaching materials, uniforms and salaries and allowances for a number of local instructors, and adequate supporting and administrative staff. The Netherlands contribution includes four qualified consultant-instructors, vehicles, large amounts of field and office equipment, and also a number of fellowships.

The initial target as projected in the Schedule of Operations was to train a total of 240 intermediate level staff by 1983, but this has now been revised in view of the manpower planning document outlined above. (see Table 1).

The Ciawi School is one of the more recently established training institutions for intermediate level personnel for protected areas. The school is modelled on the two regional African Colleges of Wildlife Management, at Mweka, Tanzania, for English-speaking African countries and at Garoua, Cameroon, for French-speaking Africans. Presently, steps are being taken to develop the Ciawi School into a regional training centre for South East Asia.

Curriculum

Intermediate level personnel involved in the management of nature reserves should be able to understand the complexity and functioning of ecosystems and to monitor and evaluate conditions and trends in components of the system. They should be able to evaluate the impact of human activities on the ecosystem and to take measures to curb undesirable changes. This requires a basic knowledge of biology, ecology, soil and water conservation and habitat and wildlife management techniques.

Valuable supplementary courses such as a routine repair and maintenance of equipment (vehicles, waterpumps, generators, outboard engines, etc.), personnel management and office routine are included in the curriculum. Finally, a number of complementary courses such as first aid, photography and survival techniques are deemed important. The training course at Ciawi identifies background sciences, management techniques and supporting subjects. Coefficients of importance are given below.

1—Highest coefficient: Management techniques
Habitat management
Wildlife management
Management of Conservation Areas
2—Medium coefficient; scientific background
Biology and Natural History
Ecology
Conservation Education and Interpretation
3—Lowest coefficient: supporting subjects
Introduction to environmental conservation
Conservation Law
Economic aspects of environmental conservation
Taxidermy
Map reading
Control of Fire-arms
Mechanics (simple)
Office Routine
Personnel management

Table 1 — *Manpower planning – 1981, the Directorate of Nature Conservation, Indonesia (Lukito Daryadi, 1981).*

STAFF LEVEL	DEMAND		CURRENTLY EMPLOYED		VACANCIES	
	CENTRAL OFFICE	REGIONAL UNITS	CENTRAL OFFICE	REGIONAL UNITS	CENTRAL OFFICE	REGIONAL UNITS
Directors, Sub-direct.	7	8	5	-	2	8
Chief wardens[1])	110	519	32	114	78	405
Rangers[2])	156	2418	40	674	116	1744
Guards[3])	77	1488	30	891	47	597

[1]) Level III, Kepala Balai and Kepala Sub-Balai.
[2]) *Level II,Kepala Rayon.*
[3]) *Level I, Kepala Resort.*

4—Extra curricular subjects
First-Aid
Survival Techniques
Photography
Zoo Management
Snorkelling, diving
Sports
English.

The course duration is of 9 to 10 months, comprising 20 weeks of classroom instruction (544 hours lectures and 102 hours demonstrations, laboratory work) and 15 weeks of fieldwork in various parks and reserves in Java, Bali and southern Sumatra. Usually, fieldwork alternates with brief periods at the School preparing reports, analyzing data and getting ready for the next field trip. Emphasis is put on the practical application of class and field instruction.

During the first semester (October-March) a number of one- or two-day excursions to relevant institutes, museums, botanical and zoological gardens are organized. Extra-curricular activities include lectures by guest speakers and specialists in the field of Environmental Conservation and other subjects, slide programs and films and also students' participation in the preparation and planning of interpretive programs, guidebooks etc.

Ciawi's Achievements

Although no attempt has been made to evaluate the effects of the training courses so far given at Ciawi, without doubt the School has contributed to the improvement of the management of protected areas in Indonesia. More importantly, the School has boosted the image of PPA and the status of its personnel. Already the management of most important parks and reserves throughout Indonesia is now planned, implemented and supervised by Ciawi-graduates.

Four training courses have been completed since October 1978. The number of participants in each course is given in Table 2.

Ciawi student plotting nesting sites, Pulau Rambut Bird Sanctuary.

Table 2 — *Number of participants in the first four training courses at School of Environmental Conservation Management, Ciawi.*

Year	Indonesian participants	Foreign participants	Total
1978/79	29	—	29
1979/80	33	—	33
1980/81	36	1	37
1981/82	26	2	28
Total	124	3	127

From experience we have learned that there are considerable problems of organization in dealing with groups of over 30 students in one class; moreover, the transfer of knowledge and skills particularly during field exercises, becomes less satisfactory when the group size exceeds 30. At present dormitory and catering facilities at the Ciawi School are limited to 40 participants, but we feel that the ideal number of participants for each course is 30.

So far, three non-Indonesian participants have successfully completed the course. There is a strong possibility of extending the role of the Ciawi School as a regional School for the whole South East Asian region, (see Future Developments).

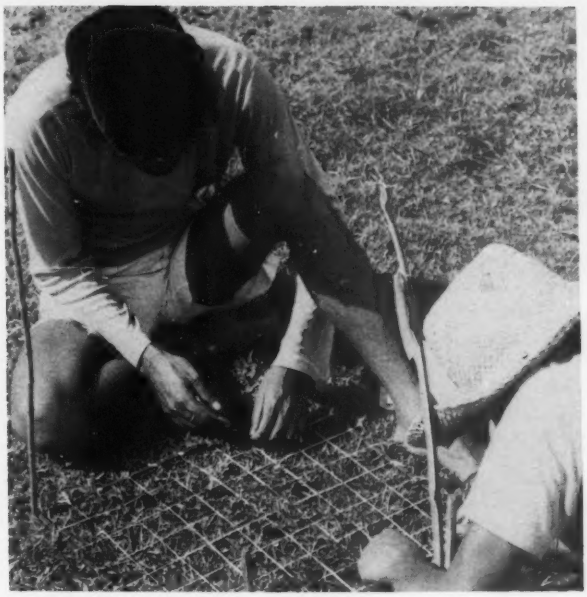
Constraints

Timing and organization: Initially, the Ciawi School aimed at upgrading the skill of personnel of PPA already in service. This has caused certain constraints in the timing and organization of the course. The participants had to be released from PPA-duties for the duration of the course. In many cases they also separated from their families for a long period of time, which, in some cases, undermined morale, particularly when family problems such as illness occurred.

Heterogeneity: A problem encountered in most in-service training is the range of experience of the participants. Participants in the first four courses at Ciawi varied from freshly trained university graduates with little or no field experience to very experienced officers a few years away from retirement. Lack of homogeneity in previous education and experience of the candidates is one of the greatest handicaps to the effectiveness of training courses. However, it is almost impossible to have all participants with the same level of education and experience when the course is given to personnel already in service. Similar problems have been encountered at both African colleges, and a partial solution is to introduce an age-limit, e.g. in Garoua, since 1978, participants must be between 17 and 30 years. Another solution would be to recruit candidates directly from among people leaving school.

For those direct-recruits, the diploma of the Ciawi School could then become a prerequisite for entering PPA's service. It is expected that this will happen in the near future.

Financing: It is a fortunate situation that until now the Ciawi School has known little or no financial constraints. However, a nine to ten-month training course involving five to six field trips of 7 to 14 days duration is a costly enterprise. Very few countries can afford to maintain special training institutions for protected-area personnel. In fact both African schools would not have operated successfully without generous financial and technical support from both international and national public and private organizations. Indonesia is investing an amount equivalent to US $7,000 for each Ciawi graduate, not including the salaries of participants and staff. If the standard of the course is to be maintained, particularly the realization of the targeted number of days fieldwork, it may be necessary to apply for external financial assistance or to call for international or regional cooperation.



Vegetation analysis on Cigenter grazing ground, Ujung Kulon National Park, West Java.

Language of instruction: in view of the expected future regional role of the School, English was chosen as the language of instruction. Most hand-outs, documents and library books are in English, but the command of the English language of most participants proved inadequate. For this reason, a five-week refresher course in English is organized at the beginning of the school year, i.e. during September and early October. The results of these courses are rather disappointing. Many participants do not fully realize the necessity of having a good command of English and miss part of the instruction. Most Indonesian instructors teach in Bahasa Indonesia. So far this has not caused major problems among the foreign participants as these were all from Malaysia. However, when countries other than Indonesian and Malaysia are going to use the Ciawi School, *all* instruction and teaching materials will have to be in English. This may present problems for a number of local staff members.

Future developments: recommendations

New recruits: When eventually direct recruitment from school leavers is considered, the minimum requirements for admission should be clearly defined: applicants should have passed sixth level education or hold an equivalent qualification, be physically fit, show a keen interest in nature conservation, have a good work incentive and show initiative. They should also be prepared to fulfil their future duties by living in remote areas, often having to work away from their families under arduous conditions.

Value of the diploma: The diploma of the School should be a qualification for admission or promotion in the ranks of the Civil Service, i.e. its 'civil effect' should be clearly stated and accepted by the participating governments. Newly recruited staff should already be put on the payroll on a probational basis during their training. Definite employment in the service should depend on whether they complete their training successfully.

Participation from other Institutions: Apart from the expected continuous demand for training for PPA-staff, other institutions in related field may wish to use the Ciawi School for training of their intermediate level personnel. These could include the Forestry Department (now responsible for visitor management in protection forests and buffer zones adjacent to parks and reserves on Java), the Officer of Tourism, university faculties of nature conservation and wildlife management, etc.

Marine Conservation: In view of the vast area of seas and oceans in the Southeast, it would be sensible to pay special attention to marine conservation and island ecology. The current curriculum of the Ciawi School does include some marine ecology and management of marine parks but these courses should be expanded.

After service: There will be a continuous need for post service training, i.e. refresher courses, seminars and workshops on specific subjects, new techniques and new developments for Ciawi's alumni. These short courses should be arranged either once a year or once every second year. The spirit of the *corpus alumni* could best be maintained by issuing a School newsletter or journal (four issues a year), which should be sent free of charge to all Ciawi graduates.

Regionalization: The possibility of promoting the Ciawi School into a regional school for Southeast Asia has been considered from the beginning. Project proposals have been forwarded to ASEAN countries and many countries seem to be interested. It is hoped that further steps toward regional cooperation will soon be taken in order to lessen the financial burden to Indonesia, and to guarantee continuation of the School on a permanent basis.

If the School did become a regional centre it is likely that international organizations such as UNDP (FAO), World Bank, EC and bilateral agencies for technical cooperation would also take a keen interest and support it financially and technically.

At present we have no realiable estimate of the numbers of staff who might come to Ciawi from interested countries in Southeast Asia. A questionnaire on this matter is currently being processed through the Ministry of Development Control and the Environment of Indonesia. It is expected that training needs in the region fully justify further investment in the Ciawi School.

One of the conditions for success would be to simplify and standardize the Indonesian Government's procedures for invitation and admittance of prospective students. Futhermore, some of the School's facilities should be extended and improved. Teaching staff should be of high standard and fluent in English.

It is recommended that before developing the Ciawi School as a regional Southeast Asian training school, the problems and advantages of regional participation are studied at both regional African Colleges.

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H. M. Duryat is Director of the Institute for Agricultural Education, Training and Extension (IPLPP), Ciawi-Bogor, Indonesia.

L. P. van Lavieren, from the Netherlands, heads the technical assistance team cooperating with the School of Environmental Conservation Management.

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Alan H. Robinson
and Abdul Bari

Komodo National Park: Progress and Problems

Komodo, as one of Indonesia's first five national parks, has already been desribed in PARKS (Vol. 6 No. 2, p. 4). The following article concentrates on recent physical and administrative progress, together with continued problems facing the Park's managers.

Briefly, Komodo National Park consists of the two substantial islands of Komodo (33,937 ha) and Rinca (19,825 ha), together with dozens of small offshore islands and approximately 71,000 ha of surrounding marine waters. The Park lies in the Lesser Sunda islands 500 km east of Bali, in the straits separating Sumbawa and Flores. The area's principal conservation objective relates to preservation of the giant Komodo monitor lizard *Varanus komodoensis*, an endangered species and the world's largest known living lizard. Secondary values of the Park include conservation of some of the least-disturbed remaining dry lowland forests in the Lesser Sundas, a limited yet characteristic fauna of the Wallacean zoogeographic region, and some excellent coral reefs.

Several small village enclaves are within Park boundaries, nearby islands are inhabited, and there is a history of poaching of rusa deer (protected throughout Indonesia), man-caused wildfire, timber theft and disturbance of coral reefs with bomb fishing. Wildfire is perhaps the most significant man-induced impact, maintaining over one-half of the Park as a grassy palm savanna. This in turn appears to favor the rusa deer (a prey animal for both monitors and men) while also leading to soil erosion and further destruction of the forest mosaic needed for a balanced monitor habitat.

Despite relative remoteness, tourism potential is considered high for special interest groups. A management plan was produced by the FAO National Parks Project for the Directorate of Nature Conservation (PPA) in 1977. Progress in implementing this plan is outlined below.

Recent Progress

Until 1980, progress in Komodo was minimal since the area was administratively remote, and had virtually no regional framework to support, supervise and control its small field staff. A regional headquarters now exists in West Timor, with responsibility for Bali and the Lesser Sundas. Strong leadership from the region, plus designation of a resident special assistant to oversee development of Komodo, is probably the most important single factor promoting recent progress.

More specifically, substantial development totalling over US $500,000 have been released by PPA for the implementation of the management plan's proposals.

In early planning it was agreed that all facilities should be constructed in an architectural style appropriate to the local environment, and not the standard cement block construction which is administratively easiest to commission. A talented Indonesian architect with a special interest in adapting traditional styles was engaged to provide a site plan and construction drawings consistent with local village designs. The result has been several variations on a theme of a stilted grass-thatched wooden structure which appears traditional, provides good ventilation and space, and which blends well into the surroundings. Building sites have been selected so that a minimum of structures are visible from the sea as visitors approach the development area.

In terms of personnel, administration and operations, progress has included construction of a headquarters, four staff houses, a dock and a water system on Komodo itself. Also recently put in service has been an SSB radio link to a regional network, a sturdy 7-ton locally built motor vessel and several small outboard-powered patrol craft. Within present construction contracts are eight guard posts at critical points on Komodo, Rinca and Padar, and additional barrack-style staff housing. Personnel have increased by about 40 percent, including specialists such as boat crew and mechanics.

Development of visitor facilities is also underway, with two out of a proposed seven tourist "pondoks," each with eight beds, now completed on Komodo; an information station and support offices are now functioning in the "gateway" town of Labuan Bajo in Flores. A principal Park visitor centre, additional pondocks and a field laboratory are scheduled for completion in 1983-1984.

In planning visitor facilities, especially capacities and routes to approach the Park, close cooperation has been maintained with the local provincial government tourism planning and promotion plans. Komodo and several other natural areas managed by PPA will be important destinations. Such cooperation has already been mutually beneficial. For example, PPA has successfully stressed the concept of small-scale special interest tourism (as opposed to mass tourism) to insure minimum impacts on the Park's major objective of *Varanus* conservation. In turn, PPA has accommodated local government's desire to promote economic development in gateway cities by cancelling earlier plans for a small airstrip on Komodo itself, which would have allowed tourists to enter the Park directly without overnight accommodations en-route. Instead, an airstrip in Labuan Bajo (four hours by boat from Komodo) is nearly ready for service, and a small hotel site plan in that city is now under review.

In terms of actually better managing and protecting Komodo's resources, the physical development is beginning to pay off. Having adequate patrol boats with radio links has made it much more efficient to patrol the dozens of remote bays and little islands. With the aid of local police, over 50 persons have been recently arrested who seemed to have been operating in organized groups sent from nearby islands to cut the valuable lontas palms or to hunt deer. As more staff move permanently to the new facilities on Komodo, much quicker responses can be made to daily problems. And since the majority of staff housing is being integrated into the village structure, it is anticipated that better relations with local people will develop.

The bay called Loho Liang has been chosen for the principal development area on Komodo. A dock headquarters, visitor center and tourist cottages are under construction here.

Continuing Problems

Illegal hunting, timber cutting and fishing practices

Although there has been progress in controlling these activities, it is obvious that the Park's large size and poor accessibility will continue to make it difficult to be effective throughout the whole area. Patrol capability will continue to be required, but it may be more cost-effective to shift emphasis from catching the many scattered poachers to controlling the organized operators and enforcing the ban on sale of deer meat in local markets in Sumbawa and Flores. This will mean getting greater police support and harbor control, as well as cooperation from the judicial system in prosecuting those arrested. In the case of Sumbawa, this is made more complex since that island is actually in another province; and there is more suspicion among Sumbawa officials that their province will not share equally in the tourism benefits of Komodo's development.

Ultimately of course, the degree of local government and popular support of the Park will depend on the extent to which these groups perceive the Park as being valuable to their own interests. In the near future, it does not seem realistic to simply use conservation education to convince many hundreds of potential poachers from different villages on the nearby islands of the intrinsic world conservation value of *Varanus komodoensis*. Nor is it proper in this case to suggest parts of the Park should be made available as a buffer zone to sustain what appears to be commercial operations benefiting far-distant residents. (The situation for enclave villages may be different — see below.) Successful control of those outside-originating disturbance will simply have to depend on convincing local government administrators that they should exercise their considerable influence and authority to prevent organized poaching at its origins, even though there may not be any direct alternative sources of income to supplant this loss. In seeking support of local government, PPA should continue to show willingness to promote alternate access routes which would bring tourism's economic benefits to the provinces and both sides of the Park. More specifically, PPA must continue to encourage development of certain other reserves in which deer hunting might be allowed, and to cooperate with the Forestry Service in providing alternative plantation timber sources.

Enclave Villages

One small village each on Komodo and Rinca have existed for many years prior to Park establishment. The present management plan calls for these to continue, without allowing expansion, as enclaves within the Park, with low-level non-destructive fishing as a principal means of subsistence. Village residents would, in theory, provide a source of labor during development phases, and later serve as guides for tourists and eventually become patrol staff. This relationship was intended to establish a sense of participation in Park development and operation, and therefore minimize the frequency of villagers themselves poaching, setting fires or acting as agents for outside sources.

It is too early to make a final judgement but initial response has not been too encouraging. For various reasons, including a lack of skills and unfamiliarity with working for a salary, villagers have participated very little in the construction labor force. At the same time there has been some continued evidence of poaching, and a tendency to take advantage of the growing number of tourists by charging inflated prices for transportation and other essential services. Noticeable expansion of the village has taken place both from new people moving in as well as natural population growth. Further growth could be expected, without family planning, as public health improves with installation of PPA-sponsored drinking water and sanitation facilities.

Continuing to allow fishing near the enclave villages has always been envisioned as a sort of marine buffer zone, but this issue is made more complex by the traditional use of these and other areas in the Park's waters by villages located outside the Park. The frequent use of explosives for fishing by some of these outside villagers has made it difficult to distinguish between impacts of outside people and enclaves. Collection of tamarind fruit, bamboo and firewood for use and limited export from the enclaves is now in progress on an informal zone and permit basis, but it has proved extremely difficult to prevent accidental or purposeful wildfires being set during such collection.

The uniqueness of these enclave villages, each having a separate language and differing origins and cultures, has made PPA reluctant to suggest that they should be removed from the area, although local government has made such a proposal. PPA has remained optimistic that a

The Giant Komodo Monitor Lizard Varanus komodoensis, *an endangered species, survives only within Komodo National Park and in certain as yet-unprotected coastal areas of Flores.*

The National Park headquarters is being built in a simple local style in the development area some 5km from the enclave village. This distance should insulate the village to some extent from social impacts of tourism, yet still allow some economic links to develop.

Photos: Alan Robinson

better relationship will develop once permanent staff and tourism facilities are functioning near the village (on Komodo). The next several years will obviously be a critical period to see if a reasonable pattern of co-existence can develop.

Tourism Impacts

Although care has been taken in setting tourists capacities low, it is not yet possible to predict all impacts — social and ecological — that increased tourism will have.

For example, there is already evidence that enclave villagers have responded to the economic possibilities of providing services to tourists. The impact of such cash income on the existing rigid labor-barter system (and the internal power structure which supports it) is uncertain. Concerned about social impacts, and for logistic and health reasons, the tourist facilities are being developed some distance from Komodo villages. Although this will minimize contact with tourists and villagers and perhaps minimize social change, it will also tend to reduce tourism's economic contribution. Perhaps it will still be possible to develop controlled links via employment as guides, to provide foodstuffs or some handicrafts; but it may also be appropriate to consider direct subsidies to village services such as providing a better school, maintaining and expanding the water and sanitary systems, and initiating tree-planting programs.

Expanded visitor numbers may have adverse impact on local populations of *Varanus komodoensis* simply because of the current practice or providing a bait to attract the lizards to a convenient viewing area. Already some animals may have become dependent on the baits, and others are losing their inherent fear of humans — with potentially dangerous effects.

Analogies to other parks where baiting has ultimately proved unacceptable are not being ignored, but the Komodo situation differs somewhat in that visitors may well have travelled many thousands of kilometers at considerable expense specifically to see the monitors during a necessarily short visit. Various solutions are being considered, including reducing the total amount of bait offered, erecting a barrier around visitors, and shifting baiting stations. The most favorable long-term alternative is to create through interpretation the appreciation that it is the Komodo ecosystem in its entirety which is the rationale for the National Park, and not just the lizard in zoo-like isolation. From this appreciation should come an expansion of visitor interest from viewing the lizards feeding at a bait to a more balanced look at the Park through nature walks in the interior, examining predator-prey-habitat relationships and even getting involved in the marine resources. This should decrease the emphasis on artificially attracting monitors, and concentrate on demonstrating how strongly linked conservation of the monitor is with conservation of its namesake island.

Conclusion

Remoteness, ruggedness, a wide expanse, a tradition of human interference all add to the challenge of providing effective management in Komodo. On balance, the results of the past five years of planning and development are encouraging. If the impetus of this initial enthusiasm can be translated into sustained operation of management and tourism facilities, the prognosis seems quite good for the lizard and his lair.

Alan H. Robinson is a U.S. National Park Service park planner and marine biologist on leave to FAO for service in Indonesia with the FAO/UNDP National Parks Development Project.

Abdul Bari is the Regional Chief for Bali and the Lesser Sundas for the Directorate of Nature Conservation and Wildlife Management (PPA).

Alan H. Robinson and Yus Rustandi

Bali Barat National Park

A wildlife reserve, an uninhabited island, and expanses of primary forest are still to be found in west Bali — Bali Barat. Together with some of Bali's finest coral reefs, these form a newly proposed National Park, to be managed by the Directorate of Nature Conservation (PPA) assisted by the provincial Forestry Service. Simple visitor facilities already exist, especially for those who enjoy snorkelling, scuba diving or just exploring a wild tropical coastline.

Travelling To Bali Barat

Public bus transportation is available from Denpasar to Gilimanuk (135 km/3,5 hr) or through Bedugul and Singaraja (200 km/5 hr). From Surabaya, daily busses go eastward to Gilimanuk (275 km/6 hr). Simple shelter accommodation is available and small hotels are found in Negara or Singaraja.

Public transportation is convenient only for visitors wishing to stop briefly without staying overnight or going out to Pulau Menjangan. To organize an overnight stay, with snorkelling or scuba diving, reservations are necessary through the Bali Barat Reserve concessionaire, Natrabu Tours, in Denpasar. Tours with accommodation in a simple guest house near Teluk Terima can easily be arranged. To enter the reserve off main roads a permit is required, available from PPA in Gilimanuk or in Denpasar at Jl. Suwung 40 (Box 320).

Once common throughout Southeast Asia, the wild ox or banteng (Bos javanicus) *is now quite rare. Several hundred animals survive in Ujung Kulon and Baluran National Parks, both on the island of Java, and in Bali Barat National Park. Photo: Jeffrey A. McNeely*

National Park Proposal

A general principle of planning in Bali is the concept of the whole of Bali as a "park island." This principle means integrated conservation of natural as well as cultural landscapes of Bali, for the benefit of both Indonesians and international visitors.

Bali Barat National Park will be a major step toward the park island concept, but only one of the commitments which must involve agencies dealing with nature conservation, timber production, culture, socio-economics and tourism throughout Bali.

The Park will include three major elements: the 19,650 ha Bali Barat Wildlife Reserve; 6,220 ha of coral reefs and marine waters; and 50,000 ha of primary montane-Protection Forest. Certain areas already converted to production forests will remain in production but be managed as a "buffer zone" to protect essential Park resources while also providing some firewood, construction timber and animal fodder for human settlements nearby.

Other lands (coconut and eucalyptus plantations and enclave villages) are serious disruptions and will slowly be replaced with natural habitats.

Visitors will be welcomed in small numbers and under regulations necessary to protect the Park's natural values. Visitor use is initially focusing on Pulau Menjangan, but since the island is too small to tolerate development, a small hotel, guard post and information center will be built on the nearby mainland. Improvements are being made at Jayaprana Grave site and Banyuwedang Hot Springs. Eventually walking trails will enter more remote areas for nature study, hiking and camping.

Control and management will be improved through additional guard staff and patrolling. A visitor center and headquarters will be located at Cekik, and construction education programs, maintenance and staff housing will be in Gilimanuk.

The Landscape and Climates

The proposed park extends from rugged volcanic mountains through alluvial flatlands to the coast. These western mountains have been inactive longer than Bali's central and eastern mountains, and therefore have older, deeper soils and contours softened by erosion. Many rivers arise in the watershed, all essential for irrigation in agricultural land below.

In contrast, Pulau Menjangan and the adjacent peninsula have shallow soils on a carbonate base from an ancient uplifted coral reef. Today, modern coral reefs fringe the coast, extending 100-150 m from the shore before falling steeply to the sea floor at 40-60 m depth.

There is a single wet season from December through March, with drier more stable weather April through November. August is the windiest month, North is noticeably drier than the south, since clouds arriving from the southeast usually drop their rain south of the divide.

Wildlife and Vegetation

Although parts of the Reserve are much disturbed, Bali Barat still provides habitat for some of Bali's rare birds and mammals. Most well-known is the Bali starling *Leucopsar roth schildi*. This handsome blue-faced white starling is Bali's only endemic bird, with a total population of only 200-250 individuals found wild nowhere else in the world. Listed as endangered by international treaty, locally the Bali starling is a symbol of the threat of possible extinctions, and a challenge to examine broader environmental changes which are occurring throughout Bali.

Increasingly rare, banteng are also found in the wild in Bali only in Bali Barat. Almost identical to domestic Bali cattle, the remaining 30 or 40 banteng are shy open forest animals living deep inside the Reserve. Rusa deer, barking deer and the tiny mouse deer are also found in Bali Barat, as well as a number of smaller mammals including leopard cat, civets and long-tailed macaques.

Unfortunately, the small Balinese subspecies of tiger appears to be extinct, although occasionally there are unconfirmed reports of large cats in the remote mountains. The spotted phase of the leopard (panther) may possibly be holding on in these areas, and be confused with tigers.

The Park's vegetation ranges from coastal mangrove swamps through dry lowland evergreen forest characteristic of carbonate soils, to the wetter montane evergreen forest above 500 m elevation. Only on some higher mountain tops can there be found patches of moist true rainforest. Some lowland areas, through which fire passes annually, are now an open grassy savanna with a characteristic borassus (lontar) palm.

The Marine Resources

The coasts of the Reserve and Pulau Menjangan are fringed with coral reefs which are extremely diverse, colorful and attractive. Corals are actually animals which secrete a limy skeleton, and which live symbiotically with tiny plants. Collectively, hundreds of different species of corals make up the reef. A large number of different fishes occur here also, and they depend on a healthy reef for shelter, food and breeding sites. Unfortunately, in some areas the healthy reefs have been much disturbed by illegal coral mining to make plaster or building stone, by explosive "bomb" fishing, or collection of aquarium fishes with strong poison.

Pulau Menjangan ("Deer Island") is the showpiece of coral reefs in East Java/Bali. Relatively undisturbed, its clear waters offer snorkelling and scuba diving comparable to the tropics' best diving destinations. Shallow areas are available to the snorkeler and steep irregular "drop-offs" are excellent with scuba. Divers must pay attention to strong currents, but such tidal flushing helps keep the reefs healthy and vigorous.

Larger fishes are sometimes encountered, including several species of reef shark. Even more impressive is the toothless spotted whale shark, which may reach 10 m in length. Dolphins and whales are common, especially passing through the Bali Straits.

Human History and Use

For thousands of years, west Bali was densely forested, with only fertile lowland patches utilized by small farming groups. But by the early 1900s, population pressures were rapidly cutting back the the lowland forest. At that time the original Protection Forests were established under Dutch administration. Bali Barat Wildlife Reserve, itself created from a Protection Forest, was declared in 1947, shortly after Indonesian independence. Pulau Menjangan was added in 1978.

Various pressures have since resulted in conversion of some natural forest in the Reserve into production forests of teak and other hardwoods. Workers earlier employed in clearing the forest have stayed on, creating enclave villages whose inhabitants are generally poor, and who now subsist by farming or fishing, keeping a few domestic animals, and cutting firewood or animal food from the plantations. Inevitably, there are frictions between enclave residents and Reserve managers, who must protect the flora and fauna from illegal hunting, collection and disturbance by fire. These problems are now being addressed in developing realistic ways to manage the timber plantations as a true buffer zone.

What To Do and See

The most attractive snorkelling/scuba areas are around Pulau Menjangan, a 40 minute boat trip from Teluk Terima. Boating and diving conditions are best in early morning, and visitors usually plan to arrive in the area the day before. There are several interesting alternate snorkelling areas near the beach in Teluk Terima.

At the island, anchor buoys have been installed so that diving boats do not have to throw out their own anchors, which can seriously damage the coral. Sometimes weather conditions limit use, but typically a group stops at two or three different areas before having lunch at at a shelter on the west beach. Later there is more snorkelling or a 45-minute walk along a nature trail on the island. Returning to Teluk Terima, there is the option of returning to Denpasar or staying another night.

Exploring the mangroves can be exciting, especially for photographers in early morning or evening. Birdwatching is easily done on foot near Teluk Terima, or, with special arrangements, various other habitats. The Bali starling can sometimes be seen but it takes patience and effort. There is a good chance of seeing wildlife during a 3-4 km walk along the Teluk Terima River.

The Jayaprana Grave Site is an important shrine for both Hindus and Moslems. It commemorates the romantic story of a Balinese nobleman who, though maintaining loyalty to his king, is ultimately killed by royal soldiers because the king wished to marry his chosen bride. The girl however refused to submit, joining her beloved Jayaprana in death.

The Banyuwedang Hot Spring east of Teluk Terima has traditionally been used by Balinese and Indonesian visitors, who value its mineral waters for medicinal baths.

Visiting Bali Barat can be combined with trips to other cultural or natural areas. Frequently international visitors make a 2-day loop trip from Denpasar to Bali Barat, returning through Singaraja and Bedugul, where the Batukau Reserves are located. Or arrangements can be made to go on to East Java's Baluran National Park, with its broad grassy plains and abundant wildlife.

Safety Hints and Regulations

- Cerification required for scuba diving
- Check snorkle gear before setting out
- Please obey instructions of diving leader
- Never dive or snorkle alone
- Protect yourself from sunburn
- Discuss your plans with PPA Guards
- All trash must be carried out
- Spearfishing in any form is prohibited
- Collecting coral or shells (alive or dead) prohibited
- Handline fishing allowed only in certain areas
- Aquarium fishes may not be taken
- Hunting is not allowed.

Alan H. Robinson is a park planner and marine biologist with the FAO/UNDP National Parks Development Project in Indonesia.

Yus Rustandi is head of the Sub-Regional Office of the Directorate of Nature Conservation and Wildlife Management office for Bali.

Rodney V. Salm, Matheus Halim and Achmad Abdullah

Proposed Pulau Seribu Marine National Park: Conservation and Tourism

Following the early optimism of Kvalvagnaes and Halim (1979), who identified the conservation value of Kepulauan Seribu (Thousand Islands) off Jakarta, a period of pessimism set in as islands were rapidly bought or contracted by both developers and private individuals. Attention was diverted to the extension of National Park boundaries seawards in other areas. Robinson *et al* (1981) detailed the proposed marine extensions to Bali Barat and Komodo National Parks and outlined then current plans for a national park in Kepulauan Seribu. Salm *et al* (1982a) and Genolagani (1982) proposed marine extensions to the Krakatau Islands Reserve within Ujung Kulon National Park. These will be the first marine areas incorporated into national parks in Indonesia. However, interest in Kepulauan Seribu revived and the first Marine National Park in the country will be established there. A management plan has been prepared by a joint team from the Directorate of Nature Conservation (PPA) and the World Wildlife Fund (Salm *et al*, 1982 b). The process has begun to have the area officially declared and established as a Marine National Park. On the 21st July, 1982, the entire proposed park and buffer zone area (108,000 ha) was declared a Reserve by Ministerial Decree No. 527/Kpts/Um/7/1982. This is an interim measure until legislation is established to enable reclassification as a Marine National Park.

General Area Description

The islands and reefs of the Seribu Archipelago in the Java Sea rest on a substrate of mud and sand typical of the Sunda Shelf, one of the largest shallow sea areas of the world. Although in some areas of the shelf, chiefly along the coasts of Kalimantan, Sumatra and Java where large rivers flow into the sea, the water is too muddy or too fresh for growth of corals, in Kepulauan Seribu there are some fairly extensive reef areas.

There are 108 coral cays in the archipelago in addition to many submerged and sea level reefs. These extend in a northerly direction over a distance of 80 km from Jakarta, Indonesia's Capital, and have a number of more widely spaced islets and reefs extending a further 32 km west-northwest from the north end (Fig. 1). The cays are typically small (less than 10 ha on average) and reach an elevation of generally less than 3 m above sea level. Most are surrounded by a narrow beach of fine white sand.

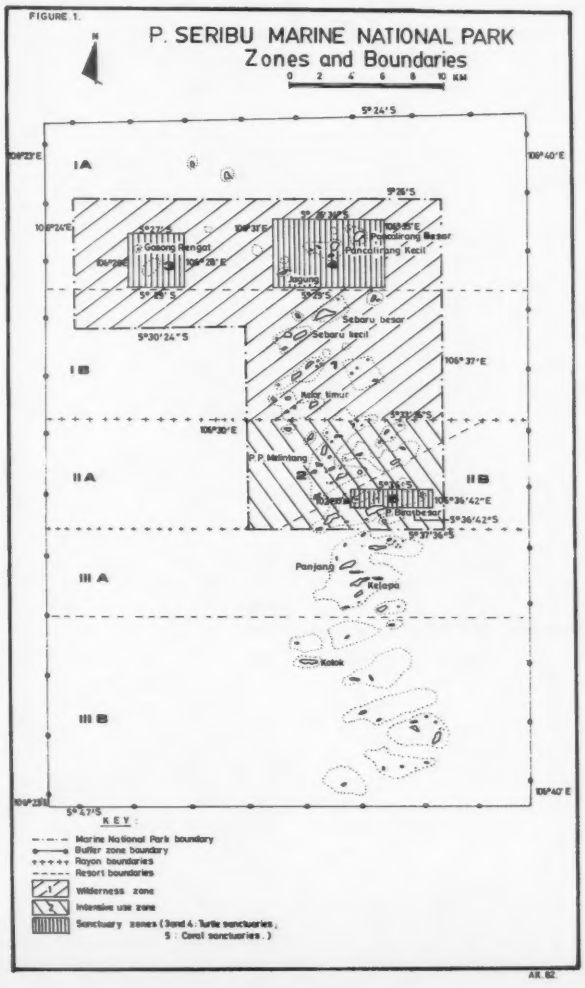
On all but the smallest cays the original vegetation has been stripped away and replaced by coconut plantations or more recently by tourist and private bungalows. An airstrip has been built on one of the islands and there is a proposal to build a golf course on another.

Description of Biota

The reefs of Kepulauan Seribu are all patch reefs which reach a maximum depth of generally between 15 and 20 m. At least two principal types of patch reefs are distinguishable: permanently submerged patch reefs and sea level patch reefs which may emerge at low tide. Both reef types offer a variety of habitats each of which displays both characteristic coral morphologies and specific biotic assemblages (Table 1). A total of 68 coral genera and subgenera comprising 132 species were identified in the proposed park area (Salm *et al*, 1982 b).

Reef fishes are plentiful in some areas and depleted in others. Valuable commercial fish species (notably groupers, snappers and porgies) are uncommon and small or entirely absent on heavily fished reefs. Other

FIGURE 1.



valuable reef species, such as the giant clam, *Tridacna gigas*, are apparently extinct throughout the islands. The shells of these clams, which are used to make flooring tiles, are now obtained by digging up the reefflats to find the shells of dead clams buried there. Other molluscs (such as pearl oysters, commercial trochus, cowries and turbans) are harvested by free divers and their stocks are seriously depleted.

Hawksbill turtles, *Eretmochelys imbricata*, form a valuable component of the fauna. They feed, sleep and breed on reefs and nest, together with a few green turtles *(Chelonia mydas)*, on the beaches of the northern islands. A total of 95 nests were counted during a three-week period in May 1981. Of these 71 were on two small cays (20 on Pulau Peteloran and 51 on Gosong Rengat). The remaining 24 nests were spread among 5 islands in the same area.

Values and Threats

The naturally beautiful islands and their surrounding reefs and waters have huge potential for both domestic and foreign tourism development, although at least 23 are privately owned. They are readily accessible from Jakarta (20 minutes by air, 1-6 hours by boat) and offer its residents many opportunities for recreation and relaxation. The small wooded islands are grouped close together and create both an attractive view and the chance to explore them. Furthermore they have enormous potential for the development of water sports (notably snorkelling, SCUBA diving and sailing), sea-scape appreciation and other beach-related activities (beachcombing, sunbathing, swimming and picnicking) as yet enjoyed by few in Indonesia, and are an exciting living natural history laboratory for education and research. Tourism is already developing into a major industry. PT Pulau Seribu Paradise currently own or lease 12 islands and are negotiating the lease of 6 others. All these will be developed for tourism.

The reefs are important for the conservation of corals and other invertebrates, fishes and communities. In addition, they are indispensable to the local fisheries that are currently sustained by them. For example, 279 small and 85 medium fishing boats are based in the buffer zone south of the park boundary. Fisheries (including harvest of reef species for the aquarium trade), coconuts and mining of coral and clam shells form the principal industries involving islanders.

The islands are important for conservation of the beleaguered hawksbill turtle which feeds, sleeps and breeds over the reefs but nests in considerable numbers on certain beaches as mentioned above. All the above values need safeguarding as they face serious problems.

Coral is mined and exported along with the giant clam shells to Jakarta. Corals are smashed further by snorkellers and SCUBA divers who stand on them, by reef-based fisheries accompanied by anchoring, walking and poling of boats over reefs, and by the commercial collectors of mother of pearl and other molluscs who operate from such distant ports as Surabaya. As these shells become rarer so the techniques to locate them become more destructive. Coral colonies are frequently smashed to render accessible the molluscs sheltering out of reach. Shells are also collected for sale to tourists visiting, for example, the hotel on Pulau Putri, or in the markets of Jakarta and Surabaya. The coral gardens of the Seribu Archipelago are one of its major attractions for tourists. Once these are destroyed the area will lose considerable value. Turtle eggs, hatchlings and adults are collected and eaten, but more usually sold to the hotel on Pulau Putri where turtle sate* and steak are standard items on the menu, stuffed for sale again to tourists, or sold for rearing on Pulau Tidung.

Potential threats to the value of the area exist in the form of pollution which could kill reef communities or reduce the value of beaches for recreation. These include discharges of oil and trash from ships approaching Tanjung Priok (Jakarta's harbor) along the eastern Buffer Zone boundary, northward expansion of pollution from Jakarta Bay, increased inland erosion and run-off of sediments causing increased turbidity of ocean waters, oil well blow-out and discharge of drilling muds and cuttings from oil drilling sites located just west of the proposed marine park.

** Pieces of meat broiled on a skewer.*

The Challenge of Design

Parts of the Seribu Archipelago are valuable to conservation for fisheries, turtle and reef protection, tourism development, research and education. But the values are being undermined by careless activities as has been outlined above. There is the need for control of these activities and for a form of management which enables both the safeguarding of all valuable elements and continued fisheries, tourism and rights of passage. The challenge is to integrate both conservation and visitor use in the same protected area without creating an impossibly complicated system of zones and regulations.

Most types of reserves are too restrictive to accommodate the envisaged conservation and development needs in the Seribu Archipelago. A multiple use reserve would serve the purpose well. However, it underrates the value of the area. By virtue of its proximity to Jakarta, hence its accessability, its high value to conservation, research and education, its large area of reefs and islands, and its need for integrated nature conservation and human use, the area would be better established as a marine national park. This would enable controls on island development which could destroy the scenic value or build piers over the reefs. Zoning of activities and adequate management can help the reefs recover, flourish and replenish stocks on nearby reefs depleted by fisheries. The hawksbill turtle nesting beaches will be kept free of seawalls and safeguarded to enable the population to build up its numbers again. In short the reefs will be kept intact, healthy and productive and valuable to their constituent communities, to conservation, to tourism, to fisheries and to education. This is the aim of the management plan.

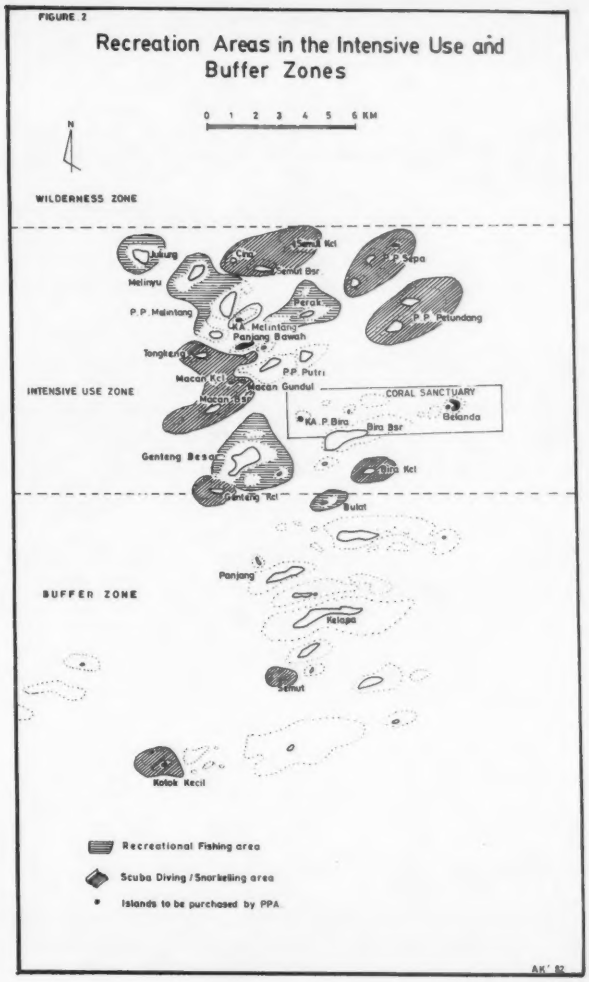
Steps in the Design of the Park

Preliminary to designing the Marine National Park, a number of steps had to be carried out. In sequence these included the adoption of a clear definition of a Marine National Park and of specific management objectives. Next, lists were compiled of activities considered to be compatible or incompatible with these objectives and potential visitor use conflicts were anticipated between former uses and those deemed permissible in the proposed park. At this stage the area was zoned and the park was designed around these zones. Finally, regulations were proposed to control activities in each zone. Table 2 lists the objectives, compatible uses and restrictions for each zone, the boundaries of which are marked in Fig. 1 and Fig. 2.

Definition of Sanctuary zones and boundaries: The areas of highest conservation interest were identified and designated sanctuaries (Fig. 1). These included beaches with densest hawksbill turtle nesting activity and undamaged reefs of high coral diversity. These sanctuaries correspond to Strict Nature Reserves.

Two turtle sanctuaries are proposed: one at Pulau Peteloran on which 20 nests were found and one at Gosong Rengat on which 51 nests were found. These two islands had 75 percent of all nests encountered in the islands. The former sanctuary boundaries include Peteloran and the beaches of its neighboring islands on which turtles nest in lower numbers and all intervening reefs and waters to provide feeding grounds for the turtles. This sanctuary doubles up as a recovery area for its reefs which have been badly damaged by explosives used for fishing. The latter sanctuary includes Gosong Rengat and its neighboring reefs and intervening waters to act as feeding grounds.

A total of 96 percent of all coral genera and subgenera and 89 percent



of all coral species recorded in the proposed marine park and surrounding buffer zone were found on a cluster of small reefs. Also included were two genera not encountered anywhere else in the area. A coral sanctuary is proposed which includes these and neighboring reefs, reef-flats, adjacent sand plateau and intervening waters. These reefs are in remarkably good condition although fishermen were seen to anchor and walk on them, inflicting some damage.

Definition of Visitor Use Zones and Marine Park Boundaries (Fig. 2): The reefs and islands surrounding the group of privately owned or leased islands, including those planned for tourism development, have been placed into an Intensive Use Zone. This zone comprises areas planned for different recreational activities. The Islands themselves are included in a Tourism Development Zone and construction activities on them will be subject to regulations and approval of PPA.

Reefs with shallow coral gardens, great scenic attraction and large, colorful, diverse and undamaged coral colonies were designated snorkelling/SCUBA diving areas. Waters adjacent to reefs of marginal value for snorkelling or diving because of currents, monotonous scenery or large amount of damaged coral were designated recreational fishing areas. Recreational fishing will be banned everywhere else in the park and surrounding buffer zone.

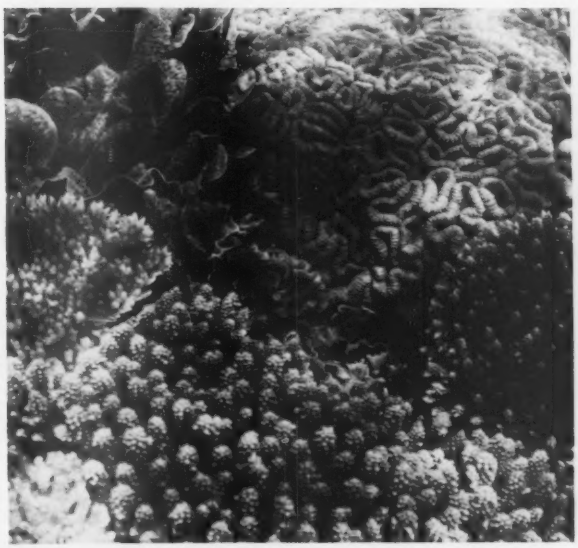
As the hotel prices on Pulau Putri are prohibitively high for most middle income Indonesians, and to provide alternatives to campers, students and the growing "nature lover" groups, a number of islands north of the Intensive Use Zone were designated part of a Wilderness Zone. This zone was expanded to connect the two Turtle Sanctuaries, the Coral Sanctuary and the Intensive Use Zone. Islands with coconut palms are excluded from this zone.

The Marine National Park boundary encompasses the Sanctuaries, the Intensive Use Zone with its included Recreational and Tourism Development Zones and the Wilderness Zone (Fig. 1 and Fig. 2).

Definition of the Buffer Zone: The entire Marine National Park is enveloped by a Buffer Zone (Fig. 1). Of overriding importance in this zone are the interests of fishermen resident in or adjacent to it. The zone is open to commercial fishing by approved methods (i.e. those which do not damage reef corals.) Only licensed island residents will be permitted to fish here. This may be a rather unconventional objective for a buffer zone; however it is an effort to compensate fishermen for the loss of fishing grounds in the Marine National Park that will become off limits. Besides, fisheries in the Buffer Zone are not seen as a threat to reef communities in the Marine National Park and this is seen as an opportunity to illustrate how protection of some reefs and their resident fish breeding stock can improve fisheries by functioning as replenishment areas. In fact, it is proposed in the management plan (Salm *et al*, 1982 b) for the park that the option of allowing certain types of commercial fishing away from reefs inside the Intensive Use Zone should be investigated after the park is established. Fishing will continue to be prohibited in the Sanctuaries and Wilderness Zones.

Administration and Patrol

Pulau Panjang (Fig. 1) has been selected as the Marine National Park headquarters island. It is centrally located, has both a good supply of fresh water and sheltered anchorage all year and is not yet privately owned or leased. The organization of staff is defined by Ministerial Decree (No. 429/Kpts/Org/7/1978 of the Minister of Agriculture). There will be a total of 16 administrative and technical staff, including the warden (Sub-Balai) at headquarters. For patrol purposes the park will be divided into three Rayons (Fig. 1), each administered by a senior ranger (Kepala Rayon) who reports directly to the warden. The Rayons are



The shallows of most reefs in the proposed marine park of Pulau Seribu are typically diverse coral gardens. Photo: Rod Salm.

divided into two patrol areas called Resorts. Each Resort has a guard post with three guards and a ranger (Kepala Resort) who reports to his senior ranger. There will be 30 field staff making a total of 46 staff in the Marine National Park.

Permits will be required for entry to the Marine National Park. These will be obtainable at the main PPA office, the Sub-Balai office in Jakarta or from the park headquarters. Visitors without permits arriving by ferry or privately owned or chartered boats will be required to proceed directly to the park headquarters to obtain a permit there.

Timing and Establishment

The backing of the Governor of Jakarta in whose administrative district the proposed Marine National Park falls has been obtained in principle. However, his signature approving the park is needed before establishment can begin. It is expected that the Governor will sign his approval before the end of 1982.

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Dr. Rodney V. Salm is an FAO marine ecologist in Indonesia working with the FAO/UNDP National Parks Development Project.

Dr. Matheus Halim is on the marine conservation section staff with Indonesia's Directorate of Nature Conservation and Wildlife Management (PPA), Bogor.

Dr. Achmad Abdullah is Chief of the Marine Conservation Section, Directorate of Nature Conservation and Wildlife Management, Bogor.

Table 1. *Classification of patch reef types in Pulau Seribu.*

PATCH REEF TYPE	ZONE	DOMINANT GROWTH FORM	DOMINANT BIOTA	
Submerged	1. Reef-flat	Branching, occasional massive	Corals:	*Acropora, Porites*
	2. Reef-slope	Explanate, massive	Corals:	*Mycedium, Echinophyllia, Oxypora, Pachyseris*
Sea level				
a) sheltered habitats	1. Inner reef-flat	Small branching, small massive	Sand and talus	(coral debris) with
			Corals:	*Acropora, Porites andrewsi, Porites* cf. *lutea*
			Invertebrates:	Holothurians, *Heliopora coerulea*
			Seagrasses:	*Thalassia*
			Algae:	*Padina, Halimeda*
	2. Outer reef-flat	Massive forming micro-atolls, branching	Corals:	*Acropora, Porites andrewsi, Porites* cf. *lutea*
			Algae:	*Padina*
	3. Reef-crest	Branching, tabular, massive vertical & vase-shaped plates	Corals:	*Acropora* spp., *Clavarina, Pavona cactus, Pachyseris, Montipora foliosa, Echinopora lamellosa, Galaxea*
	4. Upper reef-slope	Branching, vase-shaped plates	Corals:	*Acropora, Pachyseris, Turbinaria, Echinopora lamellosa*
	5. Lower reef slope	Explanate, massive	Corals:	same as reef-slope of submerged reefs
b) exposed habitats	1. Inner reef-flat	Same as in sheltered habitats	Same as in sheltered habitats	
	2. Outer reef-flat	Robust branching (bushy), small tabular, massive	Corals:	*Acropora* spp., *Porites* cf. *lutea*, faviid genera
			Algae:	*Turbinaria, Porolithon*
	3. Reef-crest	Tabular, large and small massive	Corals:	*Acropora, Prites* cf. *lutea, Coeloseris*
			Hydrozoans:	bracts of *Millepora*
	4. Upper reef-slope	Mixed, without dominant form	Corals:	mixed, without dominant taxon
	5. Lower reef-slope	Same as in sheltered habitats	Same as in reef-slope of submerged reefs.	

Table 2. *Zone objectives, compatible used and restrictions*

ZONE AND OBJECTIVES	COMPATIBLE USES	RESTRICTIONS
Hawksbill Turtle Sanctuary: Protection of the nesting, resting and feeding habitats of the hawksbill turtle *(Eretmochelys imbricata)* to enable recovery of the breeding population	1. Routine patrol, enforcement action and periodic inspection by PPA marine park staff. 2. Non-manipulative, non-extractive research subject to written PPA consent and in company of PPA marine park staff	1. Access by all but PPA marine park staff and accompanying researchers. 2. Damage, alteration, collection or extraction of all marine or terrestrial products from the reefs or islands 3. Disturbance of nesting turtles 4. Unearthing of nests & manipulation or removal of eggs
Coral Sanctuary (core zone): Protection of representative samples of reef organisms for replenishment of damaged or depleted areas	1. Routine patrol, enforcement action and periodic inspection by PPA personnel 2. Non-manipulative, non-extractive scientific research subject to written PPA consent and in company of PPA marine park staff	1. Access by all but PPA marine park staff and accompanying scientist 2. Damage, alteration, collection or extraction of all marine products whether living or dead.
Intensive Use and Tourism Development Zones: Development of tourist facilities and recreational activities, and protection of reefs and their associated habitats, communities and species from the adverse effects of these developments and activities	1. PPA approved construction of tourist or private lodgings and boat docking facilities 2. Navigation and operation of boats except as restricted by general marine park or specific recreational area regulations 3. Recreational activities except as restricted by the specific limitations of each recreation area 4. Coconut plantations and other agricultural activities 5. Any non-extractive activities consistent with the objectives of the zone and which are not in conflict with general marine park regulations.	1. Operation of aircraft at less than 500 m altitude except on the approaches to the airfield on P. Panjang 2. Operation of motorized vessels at more than 10 m.p.h. or 15 km.p.h. except in lane designated for boat passage, or in designated waterskiing areas. 3. Building of residences, catering facilities or other shelters or structures other than piers within 15 m of HWLS. 4. Felling, pruning, uprooting, transplanting or otherwise disturbing any of the following plants: *Scaevola, Hibiscus tiliaceous, Calophyllum, Barringtonia, Terminalia, Pemphis, Suriana, Tournefortia, Pandanus, Spinifex, Ipomoea, Casuarina, Rhizophora, Avicennia, Sonneratia, Bruguiera, Ceriops.* 5. Building of piers, groynes, breakwaters, seawalls or any other structure in, across or seawards of the intertidal zone without the previous written consent of PPA. 6. Digging of channels, dredging or removal of sand, rock or coral from the reefs, reef-flat or beaches. 7. All other activities prohibited by the general marine park regulations.
Pursuit zones: Pursuit of different recreational activities with maximum safety and minimum conflict with other activities and in which the effects of these activities on the environment can be contained and easily monitored.	*Snorkelling/SCUBA diving area* 1. Snorkelling and SCUBA diving at bouyed sites to pursue such non-damaging underwater activities as fishwatching, reef appreciation, photography, education, guided tours 2. Operation of glass-bottomed or glass-sided boats or boats with glass bottomed viewing buckets except closer than 300 m to occupied mooring buoys *Recreational fishing* 1. Trolling with lure and line over the fore-reef or seawards thereof for recreational purposes only	1. Standing, holding, breaking, collecting coral or other attached or free living reef life whether living or dead. 2. Feeding of fish at sites others than those designated for this purpose 1. Fishing for commercial purposes. 2. Maximum of 2 fish/person/day 3. Maximum of 2 hooks/line

ZONE AND OBJECTIVES	COMPATIBLE USES	RESTRICTIONS
		4. Spearfishing 5. Stationary fishing and anchoring 6. Drift fishing 7. Bait fishing 8. Trap and net fishing
	Picknicking/beach-based activities 1. All non-extractive beach-based activities except in locations where the activities (e.g. football, bolleyball) may damage beach vegetation or cause inconvenience to others.	1. Littering 2. All such activities which are restricted by the general marine park regulations.
	Boating 1. Access to all parts of the marine park, other than the sanctuary zones, by non-motorized vessels 2. Motorboating except as restricted by general speed limits and specific zone or recreation area limitations 3. Waterskiing in all no speed limit areas 4. Access to sanctuary zones by PPA staff for routine or extraordinary patrol and inspection	1. Speeds in excess of defined limits by all motorized craft other than PPA vessels in the course of enforcement action 2. Entry to sanctuary zones
Wilderness zone (low intensity use): Provision for appreciation of marine park in natural setting, protection of reefs and associated habitats and stocks for replenishment of surrounding fishing grounds	1. Development of PPA approved rustic accommodations and camping grounds 2. Overnight stay in designates areas 3. Non-extractive recreational activities including snorkelling and SCUBA diving at buoyed locations, beachcombing, swimming, sunbathing, picknicking, windsurfing, sailing, rowing, canoeing 4. Exploration and cruising by sailing boat or other non-motorized craft. 5. Operation of motorized vessels (maximum speed 10 m.p.h./15 km.p.h.) for access to camping sites only 6. PPA approved non-manipulative scientific research	1. Littering or discarding of foodstuffs or other materials everywhere on the islands or in the sea except in receptacles provided 2. Removal or harvest of any marine or island product, living or dead, from islands, beaches, reefs or their surrounds, except for coconuts by plantation owners. 3. Feeding or disturbance of fishes or invertabrates 4. Cutting of vegetation or damage to plant or animal life on land or in the sea 5. Overnight stay everywhere except the areas designated for this purpose 6. Construction of any form of shelter or facility, temporary or permanent, without prior written consent from PPA 7. Digging or clearing of boat channels 8. Anchoring of craft everywhere except on sandy areas away from reefs when mooring buoys are fully occupied.
Buffer zone: Continuation of all traditional or established uses and activities other than those which are damaging to the environment, incompatible with marine park objetives or restricted by regulations	1. Hook and line, net, trap and trawl commercial and subsistence fisheries except as bound by specific regulations 2. Trapping or catching of reef fishes and invertebrates for the aquarium trade 3. All non-extractive recreational activities	1. Fishing with poisons, other chemicals and spearguns 2. Anchoring, walking, poling over reefs 3. Collection and mining of coral and *Tridacna* whether living or dead, or of rock, and hydrocarbons 4. Harvest of turtles or turtle eggs 5. Possession of spearguns, fish poisons, turtles and turtle products, corals and *Tridacna* 6. Recreational fishing, except in designated areas 7. Commercial fishing, except by licenced residents of the 2 administrative districts Kelurahan Panggang and Kelurahan Kelapa in their respective districts.

PARK TECHNIQUES

Rodney V. Salm and Alan H. Robinson

Moorings for Marine Parks: Design and Placement

A good anchorage is the goal of every boatman concerned about a full night's sleep and, of course, the safety of his boat. The chances are that the anchorage will be shared with a host of other boats, especially if there is a bar and restaurant in the vicinity, or storm clouds threatening. Calm bays, lagoons and coves attract boatmen like caves attract bats, and like the latter, their presence can have a marked effect on the environment.

Boat anchors tear up sea grasses or the bed of algae that often overlies and holds together the sand or mud seafloor. In areas where boats concentrate they may constantly stir up fine muddy sediments when anchoring. This mud turns the water "milky" and animal and plant life on the bottom bears the telltale signs of sedimentation. For example, sea grass beds become thin and their leaves show many dead patches settled by invading algae. Corals may develop spots and patches covered with mud or sheets of silty mucus, and dead areas colonized by algae.

Sedimentation damage is a kind of indirect effect of uncontrolled anchoring, but direct damage to corals on reefs can be a serious problem, especially in areas repeatedly used by visitors and tour groups. Even reefs in protected areas are not safe. For example, Davis (1977) reports that 20 percent of a staghorn coral reef in the Port Jefferson National Monument (Florida-USA) was destroyed by anchors.

Anchoring poses a serious problem for managers of protected marine areas: visitors need safe anchorages, both overnight and for short periods at the reefs they visit. But, as mentioned above, anchoring can directly or indirectly destroy the very value of the area.

One option, where suitable conditions exist, is to confine anchoring to suitably sheltered areas with a coarse sand seabed and an uninterrupted flow of seawater. The coarse sand settles quickly when disturbed and the constant flushing of water will wash away finer suspended particles so that in general the water stays clear. In fact, sand generally provides a good holding ground for anchors. However, one is not always lucky enough to have such ideal conditions for anchoring and so easy a solution.

Sheltered basins with poor water circulation commonly have a seabed of fine silt or mud. As holding grounds they too are good, but allowing anchoring there can lead to the indirect damage to corals from the sedimentation described above. Snorkelling and diving areas may frequently be beyond reasonable swimming distance from favorable sandy bottom anchorages. An option in these situations is to put in permanent anchor moorings. A well installed mooring is more secure than an anchor and causes less damage to the substrate. However, few managers of protected areas are trained in the design and placement of moorings.

In some areas it may be possible to request advice from a local harbor master, yacht club, the navy or other service which installs and maintains moorings. However, this paper has been prepared to help marine reserve or park managers in areas without such advice.

General Considerations

Managers should be aware that installation and maintenance of buoys is an expensive and time-consuming process which will require routine budgets through successive years. There is also the question of legal responsibility. A mooring which has been improperly installed or poorly maintained can break unexpectedly in bad weather resulting in very serious or expensive damage to a boat and endangering lives. In many countries the agency that installed the mooring may be held responsible for such accidents.

Also, determining the areas where moorings should be placed and the total number of moorings is an important part of general planning for visitor use and development of any marine area. This planning needs to be in process or complete before moorings are put in place. For example, previous planning may have determined that some areas should be developed as marinas managed by concessionaires who will then take responsibility for the moorings. Other sites might require only a few moorings to be installed by the park authorities.

In general, park managers will face two situations. The first is where safe overnight anchorage is necessary but where it is not acceptable to allow anchoring. This situation will probably require use of large block type moorings for medium and large boats.

The second situation is where certain attractive reef areas will be visited for short periods and where overnight anchorage would not be feasible or safe. Usually this will involve only small and medium size boats; larger boats should anchor elsewhere and the people transfer to small boats to visit the reef. The moorings for these boats are usually installed by the park management itself.

Assembly of Moorings

There are four components of moorings (Fig. 1): the mooring *block* which is the anchor; the anchor *chain* or *line* which secures the mooring to the block; the mooring *buoy* which marks the position of the mooring and supports the anchor chain at the surface; and the *pennant* which is the line for attachment of the boat to the mooring. Table 1 lists the specifications of these components for boats of three size classes commonly encountered in protected areas.

Mooring Blocks — Some basic shapes of mooring blocks are shown in Fig. 2. These are usually cast out of concrete. Specific comments on each type of block are listed in Table 2.

Two rings should be embedded in each mooring block so that the anchor chain or line can be transferred to the second before the first wears through.

Mooring Buoys: Commonly encountered types of mooring buoys are depicted in Fig. 3 and the material of their construction is listed in Table 3.

Attachment of Anchor Lines: Buoys may be anchored to mooring blocks by rope or chain. Chain has several advantages: it suffers less fouling, it has a fixed length (whereas rope will stretch in strong winds), and it is difficult to cut, making theft of buoys more difficult. However, chain may be difficult to obtain; it is more expensive and is extremely heavy for deep moorings.

Chain may be galvanized or stainless steel. Stainless steel is better but it is very expensive. The diameter of the chain should not be less 0.95 cm (⅜″) for small boats and not less than 1.25 cm (½″) for medium and large boats (Table 1).

The length of the chain should be twice the depth of the water. An adequate length of chain is very important since too short a chain will cause the boat to ride directly above the block. When lifted by big waves or tides, a boat may lift the block if directly over it, or may snap the chain.

One end of the chain is shackled to the lower ring of the mooring buoy and the other end is shackled to one of the rings in the mooring block (Fig. 1). Stainless steel shackles are preferable but again they are more expensive than the galvanized varieties. Shackles should be wired to prevent them from working loose and

Fig. 1. Diagram of a standard mooring

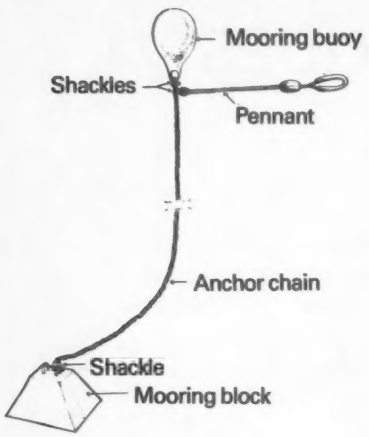


Table 1. Specifications for Components of Moorings

COMPONENT	BOAT SIZE SMALL[1]	MEDIUM[2]	LARGE[3]
Block weight	150 kg (330 lbs)	250 kg (550 lbs)	500 kg (1100 lbs)
Block ring diameter	2.5 cm (1″)	2.5 cm (1″)	3 cm (1¼″)
Anchor rope diameter	2 cm (¾″)	3 cm (1¼″)	4 cm (1½″)
Chain size	0.95 cm (⅜″)	1.25 cm (½″)	1.25 cm (½″)
Chain weight	2.27 kg/m (5 lbs/yd)	3.1 kg/m (6.7 lbs/yd)	3.1 kg/m (6.7 lbs/yd)
Buoy volume[4]	kg chain: litre vol. = 1:1.25 (lbs chain: gallon vol. = 6:1)		

[1] dinghy/small outboard motorboat (to 500 kg; ½ ton)
[2] medium inboard motorboat/yacht (500-2000 kg; ½-2 tons)
[3] large inboard motorboat/yacht (2000-5000 kg; 2-5 tons)
[4] the buoy must have sufficient volume to support the anchor chain plus its own weight, for example:

a) weight of chain + buoy = 2 × water depth × weight of chain/meter;
i.e. for medium boat in 10 m depth = 2 × 10 m × 3.1 kg/m = 62 kg
b) required buoy volume = kg chain × 1.251/kg* = 62 kg × 1.251 kg = 77.5 liters

* the conversion factor 1.251 takes into account the weight of the buoy

all metals should be galvanically compatible (i.e., do not use common wire on stainless steel).

Rope diameters are also listed in Table 1. Twisted nylon is prefered over natural fibre ropes which rot faster. A thimble should be spliced into each end of the rope. One end is then shackled to one of the rings in the mooring block and the other end is shackled to the mooring buoy.

Attachment of Pennants: Braided nylon is generally easier to handle than twisted lines and is preferred for pennants. However, floating lines (e.g., polypropylene) are easier to retrieve from the water. The diameter of pennants should be 1.25 cm (½″) for smaller boats and 2.5 cm (1″) for larger boats (Table 1). The lines should be 4-5 m long and should have a metal thimble spliced into one end and a large plastic-sleeved loop spliced into the opposite end. A small float threaded onto the line near the loop makes it easier to pick out of the water (Fig. 4).

The buoy itself should not take the direct pull of the boat to the mooring block, so the pennant should be attached directly to the chain *below* the buoy, or to the upper ring of the buoy if it is connected to the lower ring (see truncated cone buoy in Fig. 3).

Placement of Moorings

Adjacent moorings should be two boat lengths plus two pennant lengths apart. Selection of harbors and diving sites will have to have taken this into consideration. However, if space limitations compel closer spacing, boats can lie fairly close alongside each other by making fast to moorings fore and aft.

Wherever possible, moorings should be laid in less than 15 m depth. This is to enable regular safe and thorough inspection by divers and maintenance of the entire mooring assemblage, and to avoid the problems and expense associated with long heavy chains. The seabed should be level to enable the mooring block to settle squarely. The location should not be on or close

Table 2. Characteristics of Mooring Blocks

MOORING BLOCK TYPE	CHARACTERISTICS
Square-base pyramid	Good holding power once settled into substrate; best in soft sand or mud; sand will not accumulate on the block thus reducing abrasion of the ring.
Box	Common design, easy to cast; best for hard sand or gravel substrates, but good for soft substrates.
Drum	Easiest to cast, just pour concrete into an empty drum; drags easily so better used for marker buoys or small boat moorings.

Table 3. Characteristics of Mooring Buoys

MOORING BUOY TYPE	MATERIAL	REMARKS
Ball	Plastic, fiberglass, steel, galvanized iron, aluminum, polystyrene.	Usually available commercially. Plastic models come in various colors. Metal buoys require periodic repainting.
Tear drop	Plastic	Available commercially in bright colors.
Drum	Plastic, fiberglass, steel, aluminum, tin.	Cheap and easy to make from old plastic, steel or tin drums. Maintenance is high on the latter two types.
Truncated cone	Fiberglass, aluminum	Usually need to be ordered and custom made.

Fig. 2. Diagram of common concrete mooring block shapes

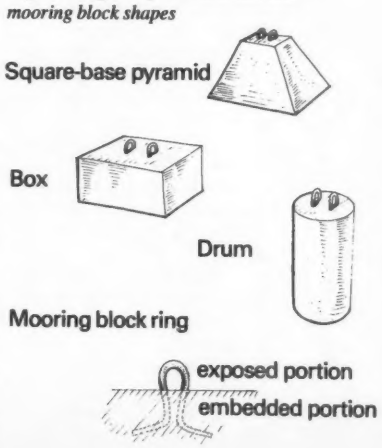
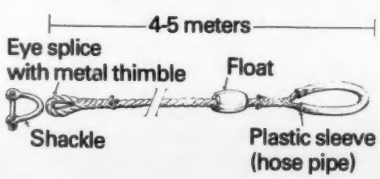


Fig. 3. Some common mooring buoy designs

Fig. 4. Pennant



to steep slopes since sand will move down the slope, and with it the mooring block. The site should be as sheltered as possible from strong winds, waves and currents during all seasons.

The mooring should be assembled completely before lowering. Installation of heavy blocks can be dangerous and inaccurate from a small boat. A better method is to lash two boats about one meter apart and to erect a tripod between them. The block is cast and the mooring assembled on nearby dry land before being slowly transported to the location on a calm day. The block is suspended from a block and tackle secured to the apex of the tripod during transportation. At the site the mooring block with attached chain is slowly lowered by block and tackle to the seabed. Keep all persons clear of the chain and lowering rope! A snorkeller in the water can direct boatmen to lower the block with precision. The same system can be used to move blocks after installation.

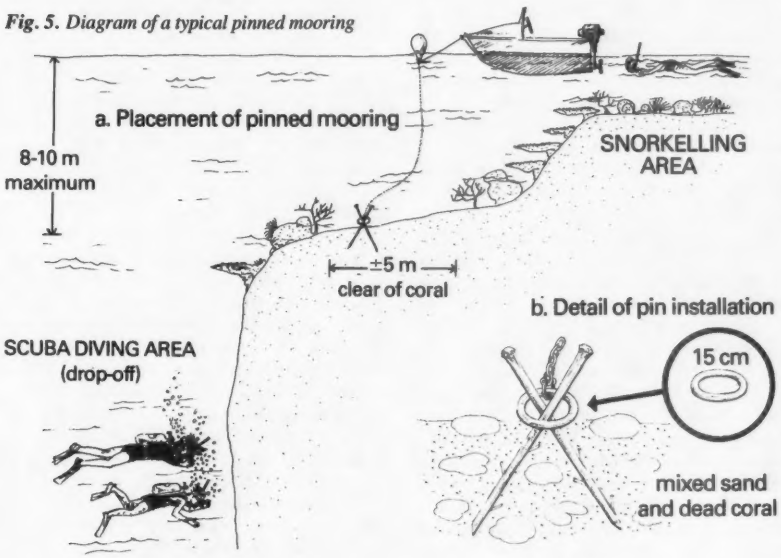
Pinned Moorings

In certain conditions, such as on narrow sheer-fronted reefs which plunge rapidly to depths greater than about 30 m, on reefs with an almost continuous cover of fragile branching corals, or on reefs lacking suitable level sandy patches, placement of block moorings as described above is impractical. In such cases moorings may be pinned to the reef in the manner described below (Fig. 5).

Pinned moorings would typically be used by dive boats during short visits to snorkelling or diving areas. This often means close to a very shallow reef that snorkellers will swim to or just above a drop off where SCUBA diving takes place (Fig. 5a). Care should be taken to pin the mooring far enough from the shallows so that moored boats will be safe during all tides and any wind direction. It is best to locate the pins in a clear or sandy area of about 5 m diameter so that the chain will not tangle in coral. Installation requires experienced SCUBA divers carrying extra weight and using 4-5 kg sledge hammers.

Stainless steel pins are best, but 2.5 cm steel bars can be used. The pins should be 1-1.5 m in length. The pins are driven into the reef at an angle of about 45° (Fig. 5b). A steel collar (15 cm diameter) is placed over the first pin after it is in place, and the second pin is then driven into the reef through the collar. The pins are angled as shown in Fig. 5b so that the collar cannot be pulled free. In very hard reefs shorter pins are used and longer pins in sandy or loose rubble areas. Short steel rods (5 cm) should be welded to the pins to act as barbs and help hold the pin in place.

Fig. 5. Diagram of a typical pinned mooring



Maintenance

The entire mooring assemblage should be inspected once every three months, and more frequently when there are signs of wear. When anchor lines and pennants become heavily covered by seaweed they should be removed and spread in a sunny dry place until the seaweed dries and falls off. Shackles must be wired to prevent loosening and both the wire and shackles must be examined for signs of corrosion and wear. The rings in the buoys and mooring blocks and chain links, particularly at the sand-water interface, must also be checked for wear.

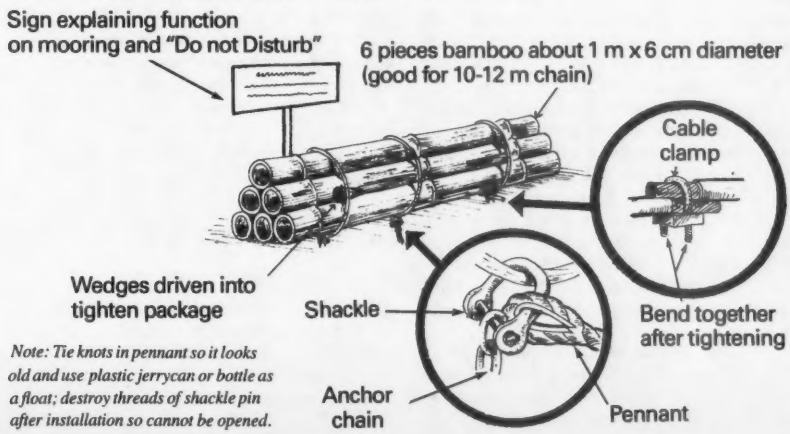
Worn shackles, chain and thimbles and frayed ropes must be replaced promptly to avoid accidents. When the ring of the mooring block shows obvious signs of wear, the anchor chain or rope should be reshackled to the second ring—and the shackle pin must be wired in place again!

Special Problems

In well established protected areas with adequate budgets and frequent effective patrols it is probably best to purchase the best quality materials for moorings, since theft or vandalism will be relatively rare. However, if funds are few, installation equipment simple and control of the area difficult, it is best to start with few buoys made from inexpensive materials. Theirs will not be a serious loss. An example of such an inexpensive buoy is depicted in Fig. 6. Obviously, it is very important to contact local fishermen and boaters, to explain why the mooring is being installed and to request cooperation.

In muddy areas, such as around mangroves, or sheltered bays and lagoons surrounded by reefs, mooring blocks may be replaced by mushroom anchors if they are available. A 25 kg (55 lbs) anchor will hold small and medium boats and one of 50 kg (110 lbs) will hold large boats. A cheaper substitute with greater holding power is an old discarded wheel from a railway truck with an attached length of axle. The axle serves an the anchor stock to which the chain is shackled.

Fig. 6. Inexpensive locally made buoy unattractive to thieves



Note: Tie knots in pennant so it looks old and use plastic jerrycan or bottle as a float; destroy threads of shackle pin after installation so cannot be opened.

Dr. Rodney V. Salm and Alan H. Robinson are marine experts with the FAO/UNDP National Parks Development Project in Indonesia.

What To Expect From The World National Parks Congress

Kenton R. Miller

The First World Conference on National Parks was held in Seattle, Washington, USA, 20 years ago. The Second World Conference on National Parks followed 10 years later at Grand Teton National Park, USA, in connection with the celebration of the 100th anniversary of the founding of Yellowstone National Park. Now the third world meeting of national park officials and the many scientific and administrative personnel who manage, protect and promote this rich natural heritage is about to begin in Bali, Indonesia.

The Congress will be held in Denpasar, Bali, 11-22 October 1982. For more information contact Mr. Jeffrey A. McNeely, Executive Officer, CNPPA, at IUCN, 1196 Gland, Switzerland, or the Congress Secretary General, Lukito Daryadi, Director of Nature Conservation, Jl. Juanda 9, Bogor, Indonesia.

PARKS asked Dr. Kenton R. Miller, chairman of IUCN's Commission on National Parks and Protected Areas (CNPPA), what is expected of this essential meeting –now called a Congress to better reflect the professional role of the experts who will attend. His reply follows.

–Ed.

As a Congress, this gathering is a bringing together of a profession or guild along with invited specialists and guests. Specifically, at Bali we shall have in one forum key individuals responsible for the custodianship of the world's natural heritage. Well over 400 million hectares of wild land and water areas have been placed in protected status by peoples and governments in 120 nations. Bali participants will include managers, researchers, teachers and interested planners, bankers, foundation officers, United Nations officers, government leaders, and private citizens from all continents.

The agenda provides for a review of progress over the last decade since the previous gathering at Yellowstone and Grand Teton in 1972, and an examination of challenges and goals for the next decade. It will feature both a celebration of accomplishments of the past and a setting of goals for the future.

More specifically, the Congress opens with welcome presentations from the highest levels of the Indonesian Government — our host — and sponsoring institutions including the IUCN, UNEP, FAO, and Unesco. This establishes a foundation emphasizing the importance and significance of subsequent deliberations.

The technical sessions begin with a statement on the current status of protected areas in the world. For the first time ever, this presentation will portray protected areas in relation to terrestrial and marine biological and physical units, and show coverage of the actual network which is in place. These presentations will be based upon years of research on land and water classification and the results of the work by the Protected Areas Data Unit of IUCN.

The major issues for the coming decade will be posed in collaboration with the six commissions of IUCN, relating to survival of genetic diversity, maintenance of ecological processes, permanence of conservation institutions, planning for regional harmony, understanding conservation and exploring how protected areas can help to meet society's evolving needs. These issues will be addressed throughout the Congress.

The major portion of the Congress will be devoted to an examination of recent experience in each of the world's regions or biogeographical realms. Case histories will be presented by individuals from the region, to share work and progress, to critique methods and techniques, and to offer guidelines for the future. Each regional presentation will feature a chairman with broad experience and knowledge regarding conservation in the realm, a keynote address to examine issues, problems and progress, the regional case studies, and finally, a statement of future directions for conservation and protected areas in the region. Thus, experts from each region will provide the basis for delineating action warranted in the coming decade.

The results of these presentations and other major contributions from a wide range of experts will be utilized by participants to prepare three manuals for use by field practitioners. Three workshop sessions will focus on Management of Terrestrial Protected Areas, Management of Marine Protected Areas, and Training for Management of Protected Areas.

The Congress will then return to the major issues and invite experts from related fields and organizations to suggest new directions for protected areas in the future. Examples include the use of protected areas in environmental monitoring, the importance of genetic resources, conservation of ecological processes, institutional frontiers, relating protected areas to development projects, and the view of world citizenry concerning protected area management.

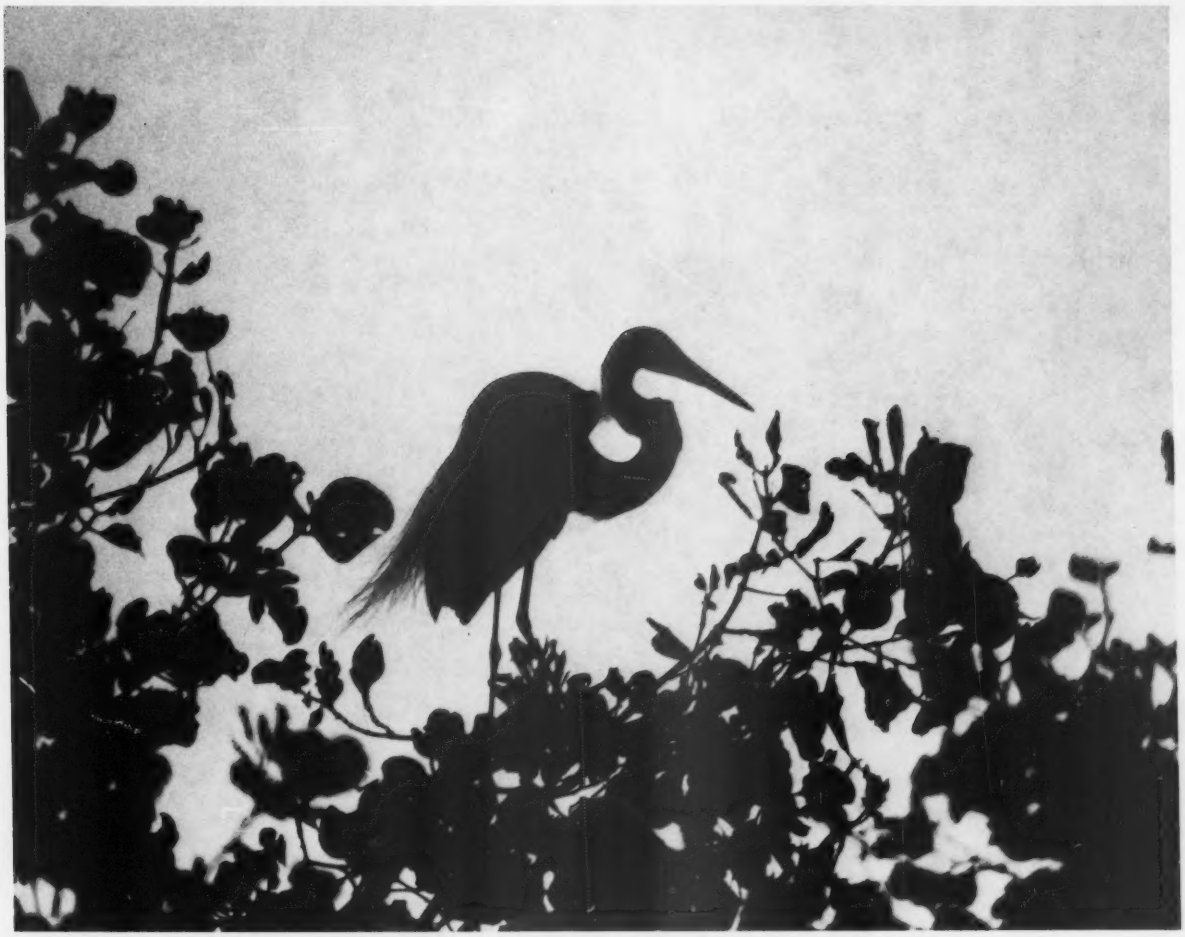
International support for protected areas management will be explored in an effort to identify new and creative ways to merge conservation with development. The World Conservation Strategy, and the roles of government, private sector, banks, foundations, and international development agencies will be explored. The emerging world-wide programs of Man and the Biosphere and the World Heritage Convention will be reviewed.

The participants will wish to prepare and announce a statement of purpose for protected areas and to reaffirm their responsibilities for stewardship for the world's natural heritage. A Bali Declaration can be anticipated both to guide the profession and to inform one-and-all of the role and dedication of protected area managers. In this regard, it is also expected that participants will wish to design improved mechanisms for organizing their efforts. It is possible that some sort of professional protected areas managers association will be recommended by the Congress.

Thus, the Congress will produce specific projects: a proceedings volume including all of the valuable case histories and other documents presented at the event; three manuals on managing tropical and marine protected areas and on training protected area managers; the Bali Declaration and a proposal for a protected areas managers association. Furthermore and equally important, the Congress will provide the mechanism for renewing ties and dedication among conservation professionals of many fields from all over the world, and to weld more strongly the relationship between colleagues working directly for development programs and those responsible for natural resources management.

The challenge is to move national parks and protected areas forward in ways which benefit society and make sustainable development possible. This challenge is made particularly complex by the need to encompass and promote new and evolving utilitarian uses of protected natural areas without losing sight of the humanistic dimensions of nature conservation. It is precisely this range of human needs and ethical perceptions which must be addressed openly and objectively. The World National Parks Congress can be expected to open this dialogue and to set the stage for a balanced approach to conservation management which will be of relevance to all peoples, north and south, east and west, rich and poor alike.

Dr. Kenton R. Miller is Chairman, Commission on National Parks and Protected Areas, IUCN, and Director, Center for Strategic Wildland Management Studies, School of Natural Resources, University of Michigan, Ann Arbor, MI 48109.



Egrets in the trees in Ujung Kulon National Park on the western tip of the island of Java. Protected since 1937, this park is one of the most important reserves in tropical Asia. It is extremely rich in flora and fauna, and protects a number of endangered species, including the Javan rhinoceros (Rhinoceros sondaicus), *of which about 50 individuals remain.*
Photo: J. McKinnon

Back Cover: Gunung Leuser National Park in Sumatra is the largest of Indonesia's older protected areas (800,485 ha) and has the richest faunal resources: 105 mammal species, 313 bird varieties and 94 kinds of reptiles and amphibians. A number of important species are protected here, including clouded leopards, orang-utans, Sumatran tigers and Sumartan rhinoceroses. This tiger was photographed in the park by J. McKinnon.

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